RAILROAD GAZETTE

FRIDAY, JUNE 10, 1904.

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The *Railroad Gazette* was issued from 1856 to 1870 in folio size. Since 1870 it has appeared in its present form, but after the current issue it will be printed on leaves 9¾ x 13 in. It is with regret that we make any change in a form to which our readers have been long accustomed, but the slightly smaller page has been approved by an overwhelming proportion of them. The change is made at this irregular date instead of at the end of a year or a half year, for interesting and sufficient reasons which will be given fully next week. A fractional year index accompanies this issue.

Contributions

Setting Locomotive Valves.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In the article on "Setting Locomotive Valves," written by Mr. J. V. N. Cheney and published in the *Railroad Gazette*, May 13, 1904, it was said that the driving wheel tram marks would have to be found to run over the cut-off. The wheel tram marks are the dead center points, and has nothing to do with the cut-off—the only marks necessary for this are the valve stem marks, assuming, of course, that the valve stem marks were made when the edge of the valve was line and line with the outside of the steam ports, which would be the cut-off points when the valve was moving to the steam port and the admission points when the valve was moving from the steam port.

It is also stated that "when the left forward end of the cylinder is taking a larger volume of steam than the right forward end," etc., "the eccentric rod should be lengthened so as to throw the valve ahead," which is an error, as lengthening the eccentric rod pulls the valve back and produces a longer or later cut-off at the front end and an earlier or shorter cut-off at the back end. Also, that when the right back end is taking too much steam, its eccentric rod must be shortened, bringing the valve stem back, etc. This is also an error, as shortening the eccentric rod pushes the valve ahead and produces a later or longer cut-off at the back end and an earlier or shorter cut-off at the front end.

In the second paragraph of the article it is stated that when squaring the valves in full stroke position or if the engine is reported "lame," no attention needs to be paid to the full stroke if we know the lead is constant. It is not clear what is meant by constant lead, and it is a sure thing if the eccentric rods are changed, "shortened" or "lengthened" to "square the valves," as is stated, the lead will be disturbed and may vary at all four points and yet the valves sound square.

It is not good practice to have slotted holes in the eccentric rods nor right and left nuts on valve rods, as solid ends with a key are more modern and much more satisfactory, as they eliminate the possibility of anyone changing the length of the valve rod, or rather the distance from the center of the valve to the center of the hole in the back end of the valve rod.

The writer of the article does not state what type of valve motion he refers to, but I presume it is the "indirect valve motion," as this is the one used on almost all American-built engines, except in a few cases of four-cylinder compound engines, the direct motion is used; that is, the transmission of the motion to the valve through a rocker arm is omitted and the motion transmitted directly by the eccentric. S. J. D.

A Swedish Engineer in America.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I recently spent about six months in America visiting the principal railroad systems, giving particular attention to shop practice and methods. During the trip I traveled about 17,000 miles, and desire to take this means of expressing my deep appreciation for the courteous and considerate treatment which I received at the hands of the officers of the several roads. The striking characteristic of the American railroad shop is its activity. Both the men and machines seem to be keyed up to the highest pitch, and work is turned out more rapidly than in my own country. Tools are run at high speed and the cuts taken are heavy. I was much impressed with the general use of compressed air and the economies effected thereby. While pneumatic tools are used in Sweden, nevertheless, compressed air has not received the attention which it merits.

I have noticed, however, that the character of the work turned out by many repair shops is not uniform. An engine which comes into the shop for general repairs may come out with imperfections. This is frequently due to the lack of proper inspection and routing of the work in the shop. For example, I do not believe it good practice for the same workman to turn up a journal or pin, and also make the box in which it is to fit. If the fit is not good, the workman will let it pass, but if one workman makes the box and another makes the pin, any imperfections will be discovered and rectified by the third party who assembles the work. I do not offer the above as a general criticism of American practice, as many shops do excellent work, and I have learned much from which we may profit. American machine tools are good, both in workmanship and design.

There is one essential difference between passenger equipment on American and Swedish railroads, namely, in Sweden all trains whether on main or branch lines are equally good, while in America, branch lines are usually operated with old, uncomfortable coaches. Of course, the road with which I am connected is owned by the Government, so that the comforts and demands of the public are paramount to money-making. For example, the toilet rooms on Swedish cars are large and clean, whereas those on some American cars are dirty and cramped. I was not very favorably impressed with the accommodations on sleeping cars. The upper berth is hard to get in and out of, and there is no place to put one's clothes and baggage. I prefer our compartment sleeping cars, in each compartment of which is an upper and a lower berth. The upper berth is reached by spiral stairs. Hooks, etc., are provided for hanging up wearing apparel. It is claimed, of course, that the American sleeper is safer than the compartment sleeper. That is, in a compartment, a thief in one berth might take advantage of the other occupant, but in this connection I may say that cases of this sort are exceedingly rare in our country. American methods of keeping records of supplies, etc., are very good. The organization at yards and terminals is also good. The division with which I am connected has shops at Boden, Sweden, close to the Arctic circle. These shops are, I believe, further north than any other railroad shops in the world. Snow covers the ground for the greater part of the year, and in the winter months, the days are very short and the light never very strong.

I was much impressed with the interest American railroad officers took in helping me study their methods, and I feel greatly indebted to them.

C. E. UDDENBERG.

Mechanical Engineer, Swedish Government Railways, Boden, Sweden.

A Rational Basis for Calculating the Braking Power of Passenger Cars.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In the *Railroad Gazette*, May 20, an abstract was given of a paper by Mr. F. M. Nellis on the braking power of passenger cars in which it was recommended to make the unbraked weight the same in all cases instead of braking a certain percentage of the light weight of the car. I believe the old method is the correct one and is based on sound principles. On the accompanying diagram of the forces existing in a four-wheel truck let

A = light weight per axle.

B = pressure between shoes and wheels, called braking power.

(For the sake of simplicity the angle between its line of application and the horizontal has been neglected.)

C = pull on the live lever.

D = retarding force or adhesion between wheel and rail.

R = radius of wheel.

Cr = coefficient of friction on rail (rest).

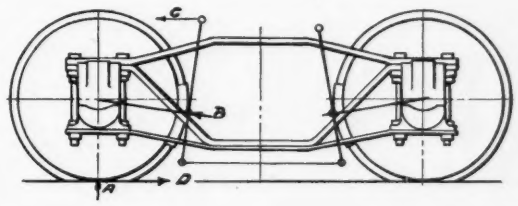
cr = coefficient of friction on rail (motion).

Cs = coefficient of friction on shoes (rest).

cs = coefficient of friction on shoes (motion).

When the brakes are applied, before a wheel slides two conditions must exist:

First, there must be a combined moment of forces tending to prevent the wheel from turning which is at least as great as the moment A × Cr × R. Although pressures A + B + C + D exist between the axle and the



journal box the coefficient of friction and the radius at which the friction acts is so small that this part of the force tending to prevent the wheel from turning can be neglected. In case the train runs in the opposite direction these pressures will be A + B + C — D, still less than before. The principal function in the moment, preventing the wheel from turning is B, the braking power. It acts on the lever arm R and is governed by the coefficient of friction cs. As soon as this moment, B × cs × R = A × Cr × R, the wheel ceases to turn.

The second condition which must exist before the wheel slides is a momentum per axle which is greater than the adhesion D, between the wheels and rails. If this momentum is greater the wheels will slide; if not, the wheels, the truck and the car will stop. If the same conditions exist on the other cars, the whole train will stop; if not, momentum will be transmitted through the draft rigging to the car under consideration and the wheels will again slide and more so now since the coefficient of friction between the shoes and the wheels has changed from cs to Cs, which is much greater.

Coming back to the passenger cars mentioned by Mr. Nellis, one weighing 50,000 lbs. and the other weighing 100,000 lbs. It is self-evident that the momentum in these two cars is 1:2 respectively. First take the 90 per cent. braking power into consideration. On the car weighing 50,000 lbs., the equation A × Cr × R = B × cs × R, or R × 12,500 × Cr = [0.90 × 12,500] × cs × R must be satisfied before the wheels will slide. Assume as an average, 3 Cr = 4 cs. Substituting these values and reducing the equation to 0, the margin of safety preventing the wheel from turning is 12,500 (1 — [0.9 × .75]) or 12,500 × .325. On the 100,000-lb. car this margin is twice as great or 25,000 × .325. In both cases the coefficient of friction between shoe and wheel must run up to $\frac{Cr}{0.9}$ before the wheel will slide.

Considering the new method of equal unbraked loads and making this unbraked load the same for the two cars previously considered, the unbraked load for the light car is .1 × 12,500 = 1,250 lbs. With the same unbraked load on the heavy car the percentage of weight braked would be $100 \times \frac{25{,}000 - 1{,}250}{25{,}000} = 95$ per cent. The margin to prevent the wheels from sliding is 12,500 (1 — [0.9 × .75]) or 12,500 × .325 for the 50,000-lb. car, and 25,000 [1 — (0.95 × .75) or 25,000 × .287 for the 100,000-lb. car and the coefficient of friction between the wheel and shoe will have to run up to $\frac{Cr}{.90}$ and $\frac{Cr}{.95}$ respectively to make the wheels slide, or, in other words, the wheels under the heavy cars will skid first. This is a mistake and the brake arrangement should be designed so that all the wheels on all the cars in the train would skid at the same time. In such a case the momentum of each car would always be taken care of by its own brakes and no surging between cars in the train would take place.

At the moment the wheels start to slide, the friction between the wheels and rail drops quickly and the shoes take a tight hold on the wheels. If the heavy car is the first one to skid the wheels, a large part of its momentum surges ahead to the adjacent car or cars of less weight and which are as a matter of course less effective in retarding the train. The greater pressure on the shoes of heavy cars has a tendency to increase the friction between them and the wheels much more rapidly on account of the rise in temperature which takes place, a fact in itself which will cause the wheels under heavy cars to slide first.

That wheels under light cars have been found to have suffered the most is undoubtedly due to other abnormal conditions as mentioned by Mr. Nellis. This has been borne out by Mr. West's experiments and a more stable basis for the cylinder pressures is undoubtedly a move in the right direction. Aside from this it seems plain that the method of equal percentage and not equal excess of unbraked weight should be followed. A. STUCKI.

Location of the Clinch Valley Division, N. & W.

Between St. Paul and Coeburn, Va. (Mouth of Lick Creek and Head of Little Tom Creek).

BY EMILE LOW, M. AM. SOC. C. E.

The work of railroad location is always a fascinating one to the locating engineer, and in a difficult country becomes one of absorbing interest. The location of the Clinch Valley Division of the Norfolk & Western Railroad presented some unusual features which were solved, perhaps, with more or less ability.

At the time the location was made the Pocohontas Flat Top coal field had just been brought into prominence by the building of the New River branch of the same company (N. & W.). The coal fields to the westward were comparatively unknown and their extent somewhat problematical, but it was to develop this new field and also to make a connection with a branch line of the Louisville & Nashville Railroad that the Clinch Valley Division was projected. The line of this railroad lies wholly in Southwestern Virginia, between the towns of Graham and Norton. It follows closely the line of three streams, Wright's creek, Clinch river and Guests river, the former a tributary of the New and Great Kanawha river, emptying into the Ohio river at Point Pleasant, W. Va., and the two latter, tributaries of the Tennessee, emptying into the Ohio river, at Paducah, Ky., two points several hundreds of miles apart.

The railroad receives its name from the Clinch Valley, lying between the Sandy Ridge on the northward and the Clinch Mountain on the south. These are two of the many spurs of the western slope of the Appalachian range, the general trend of these spurs being about S. 60 deg. W. The formation of the region is badly faulted. The course of the so-called Clinch Valley fault is to a great extent that of the Clinch river, and the magnitude of this profound break is such as to bring into juxtaposition two widely separated strata of different ages, the coal measures and the valley limestones, strata 2,000 ft. apart geologically being found in close contact. This faulting gives rise to abnormal cleavage with segregation of clay bands to an extent not found under other circumstances. The course of the Clinch river is very sinuous, and especially so between Pisgah and Cedar Bluff; between the mouths of Sword and Thompson's creeks; and also between St. Paul and the mouth of Guests river. Owing to the extreme sinuosities, the immediate river valley had to be abandoned between the points, except the stretch between Pounding Mill and Cedar Bluff, where a very bold location was used, the river in one stretch being crossed five times in a distance of about half a mile. It is, however, the province of this article to speak more in detail regarding the location between St. Paul and Coeburn, or rather between the mouth of Lick creek and the head of Little Tom creek. The original intention was to follow the north bank of the Clinch river from the mouth of Lick creek to the mouth of Guests river, and then follow this latter stream, via Coeburn to Norton. A reconnoissance made apparent the sinuous course of the two streams between the points mentioned, and also the heavy fall of the Guests river immediately above its junction with the Clinch river, where the fall ranged from 100 to 200 ft. per mile, this section of the river being a succession of rapids, hemmed in by high vertical cliffs. The difference in elevation of the Guests river at its

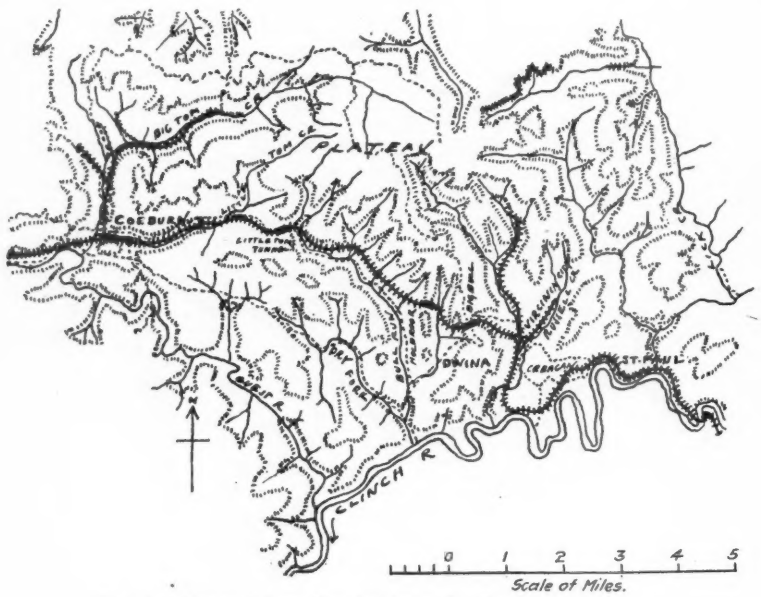


Fig. 1.—General Location between St. Paul and Coeburn.

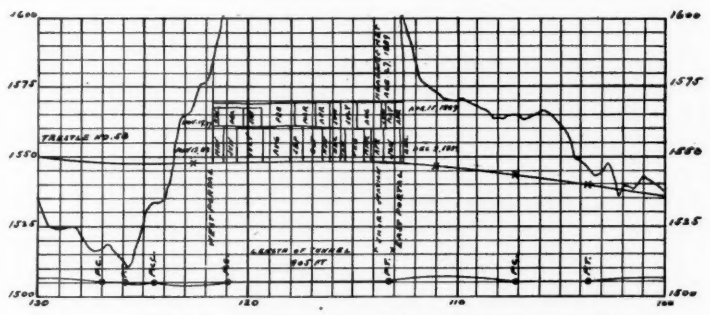


Fig. 2.—Progress of Work on Creagan Tunnel.

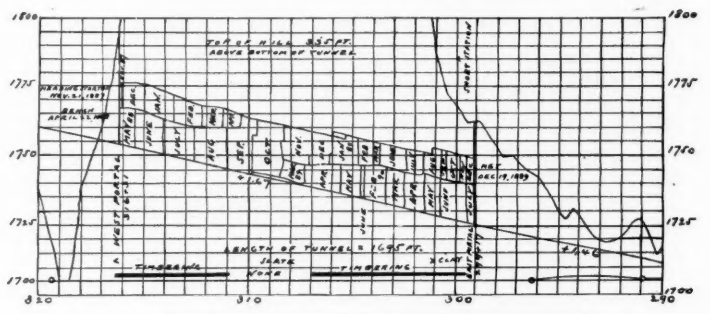


Fig. 5.—Progress Diagram, Big Bull Tunnel.

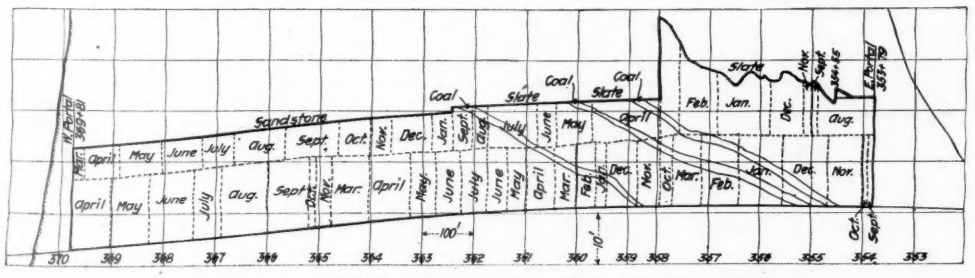
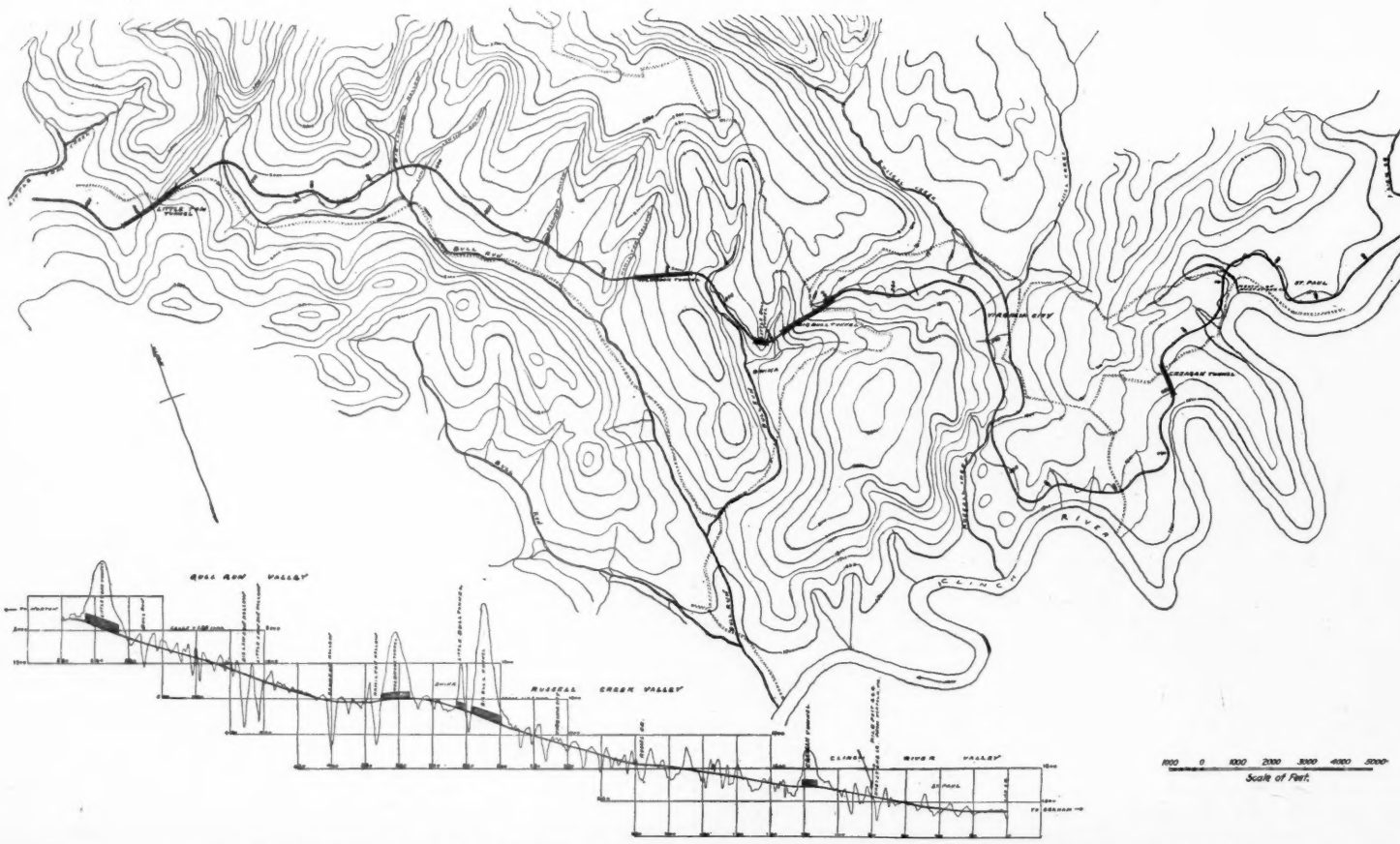


Fig. 6.—Geological and Progress Profile, Holbrook Tunnel.


BIG TOM
TOM CR.
COEBURN
OWINA
ST. PAUL
CLINCH R.
BIG BEND TUNNEL
BIG BEND
BIG BEND TUNNEL
BIG BEND
BIG BEND TUNNEL
BIG BEND

mouth and at Coeburn is about 600 ft., the distance about seven or eight miles. The concentration of about 500 ft. fall in about 3½ miles made the obtainment of a reasonable grade out of the question.

With these topographical features staring the locating engineer in the face, it was made very evident that another route would have to be found. It cannot be gainsaid that the aborigines possessed the engineering instinct to some degree, and the early pioneers and settlers to a greater extent. This is easily recognizable in the location of the early trails, followed later by horse paths and still later by wagon roads. An inspection of the small scale map of the region in question shows the location of one general and an auxiliary highway, a rather dignified appellation for what in many places is the bed of the stream or at best a narrow trail. The location as developed follows generally with some modifications the main highway between St. Paul and Big Bull tunnel, and thence to Little Tom tunnel, the auxiliary one. To speak in more technical language, the line after leaving St. Paul skirts the hillside or ridge forming the north bank of the Clinch river, climbing by means of a 1 per cent. compensated grade, until the point pierced by the Creagan tunnel is reached, thence still following the high ground skirting the river, the line passes into the valley of Russell creek, crossing this stream about two miles west of Creagan tunnel. The line then passes along the west bank of Russell creek, on an ascending grade of 99 ft. per mile, gradually rising above the valley and leaving the same at Big Bull tunnel, where the dividing ridge between Russell creek and Little Bull run is pierced. The line then passes up this latter stream to near its head, then turning abruptly to the west, passing through the intervening ridge into Bull Run by means of the Holbrook tunnel. At this point the line is over 150 ft. above the level of the adjoining valley. The line then skirts along the east slope of Bull Run, keeping about this elevation above water level until Little Tom tunnel near its head is reached. Tunneling the divide here, the line passes into the valley of Little Tom creek, a total elevation of 556 ft. having been overcome in a little over 10 miles.

Another determining factor in the location between St. Paul and Coeburn was the development of the extensive coal fields lying to the north of the Clinch river and the Clinch valley fault, which between St. Paul and the mouth of Guest river, is almost coincident with the first named stream. These coal measures and their included coal beds are to be referred to the *Middle Coal Series* of Virginia and West Virginia, identical with the *Lower Productive Coal Measures* of Pennsylvania, which in this part of Virginia carry at least five well marked coal beds, separated by varying intervals of sandstone and shales, with a sixth bed, possibly belonging to a higher series, crowning the top of the highest ridges. However, as previously stated, the exact extent of these coal fields at the time of the location was not fully known, having been developed later on, but events have shown that had the Guest river line been at all feasible, a number of productive coal areas would have been made quite difficult of access by very expensive branch lines. In such a rugged country as that traversed by the line mentioned it may truthfully be said that there is only one best line. Of course, what may be considered a best line is always open to discussion. Where expense is no object and carte blanche is given to drive ahead, the best line can generally be easily obtained, but when other considerations prevail, the problem is not so easy of solution. As has been stated, the maximum grade obtained was 90 ft. per mile (1.7 per cent.), whereas the average grade is 56 ft., equivalent to perhaps a 60 ft. compensated grade. This is due primarily to two dips in the grade line, one at the crossing of Russell creek and the other just west of the Holbrook tunnel.

It has been suggested that a line piercing the divide between the head of Lawson hollow and the headwaters of Russell creek would have eliminated Big and Little Bull and Holbrook tunnels, which have a combined length of 3,588 ft. The tunnel on the alternate line would likely have exceeded this length. The line as constructed presents some very interesting construction features. There are five tunnels on this section, the characteristics of which are shown by the following tables:

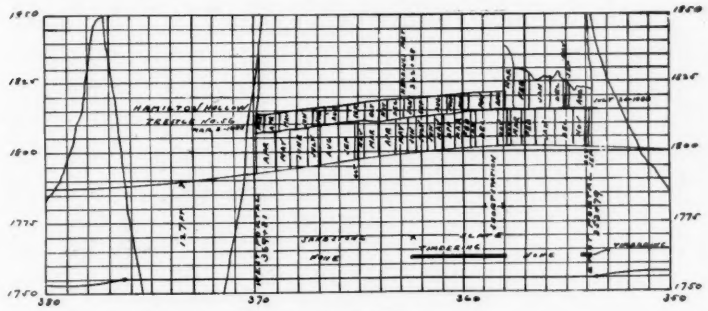


Fig. 9.—Holbrook Tunnel.

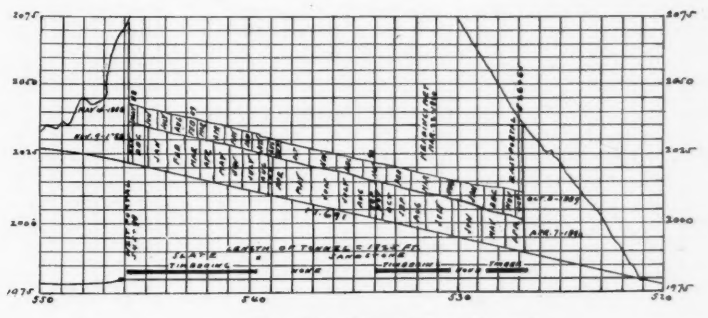
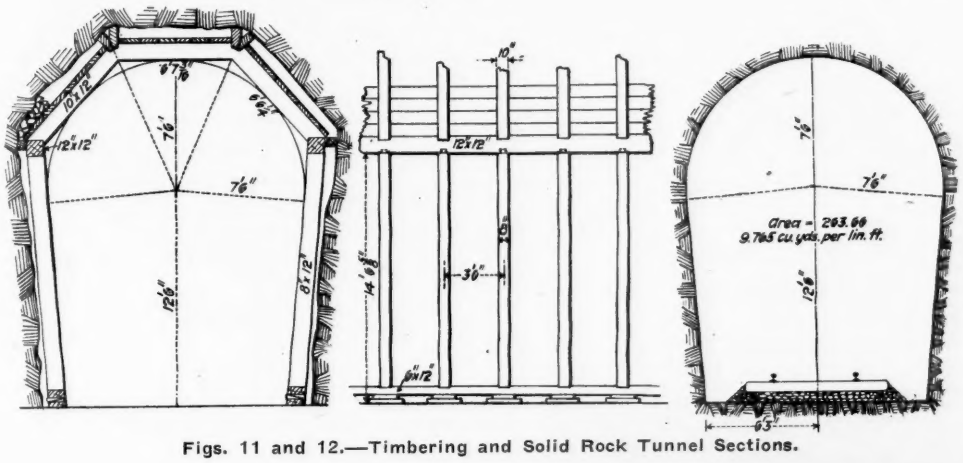


Fig. 10.—Little Tom Tunnel.



Figs. 11 and 12.—Timbering and Solid Rock Tunnel Sections.

Fig. 4.—Big Bull Tunnel—Landslide nearly Removed.

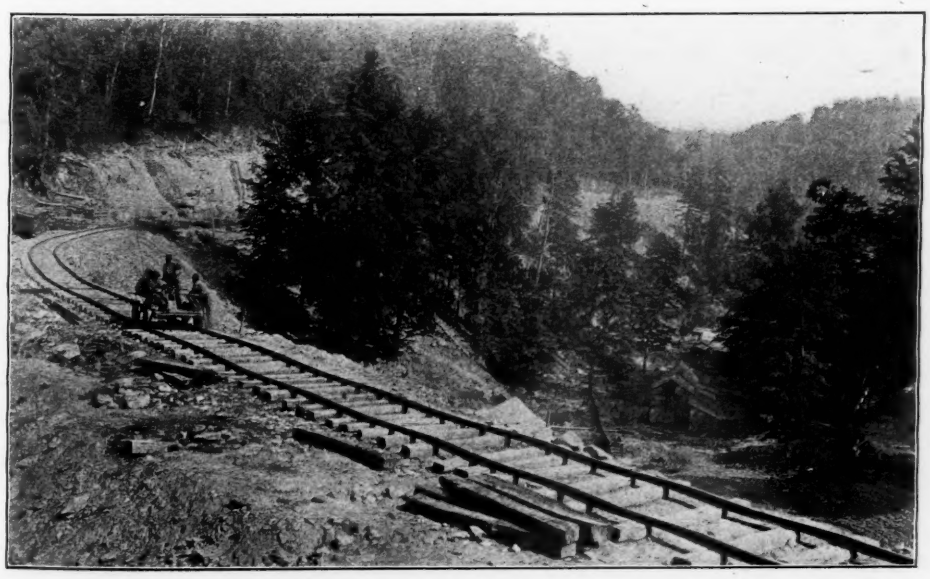


Fig. 3.—Bull Run—Camp Five, Looking East.

Name of tunnel.	Miles from Graham.	Elevation of portals.	Length, feet.
Creagan	79	1,547—1,547	905
Big Bull	82	1,725—1,754	1,695
Little Bull	82	1,761—1,766	327
Holbrook	83	1,801—1,792	1,566
Little Tom	87	1,989—2,022	1,925
Total length			6,418

All these tunnels are located on tangents, except Little Bull, which is located on a 10 deg. curve. One peculiarity of all the tunnels is that the heaviest approach cuts are at the eastern end. This is particularly applicable to Creagan, Big Bull and Little Tom tunnels. Owing to the formation of the ridge pierced by Creagan tunnel, the west end of the same opens almost at right angles to a sharp bend in the Clinch river here, necessitating sharp curvature to the right in order to obtain holding ground. Much difficulty was experienced in maintaining the embankments on the steep hillside. To have obtained a more favorable alinement a tunnel at least 1,500 ft., or 600 ft. longer than the present one would have been required. In common with the other tunnels, this one required considerable timbering, which, during the fall

of 1903, caught fire, and was only extinguished by the flooding of the tunnel, the water for which was obtained from the nearby Clinch river.

The next tunnel is Big Bull, through the divide between Russell creek and Little Bull run. The length of the tunnel is 1,695 ft., and the material driven through is a slate rock. Several seams of coal were encountered in driving this tunnel. The larger seam, which varied in thickness from 2 to 4 ft., was first met at the western end, near the top of the tunnel. It dipped rapidly and at the center of the tunnel was close to the bottom and was also thickest at this point. It then began to rise and passed the roof of the tunnel about 250 ft. from the eastern portal. Much of the tunnel required timbering and in addition at the eastern end, where the tunnel passed through soft ground, double timbering was required. Considerable difficulty was also experienced with the east approach cut at this tunnel, on account of slips and slides. A retaining wall which had been built to retain the right hand slope, was unable to withstand the pressure brought to bear on it, and was taken down after showing signs of inevitable failure. The slopes were then flattened considerably and showed signs of permanent stability, but with the advent of wet weather, and after the track had been laid through the tunnel, a slide of such dimensions occurred that about four months were occupied in its removal.

Owing to the short approach cuts of the Holbrook tunnel these gave no trouble. The material encountered in the tunnel is sandstone at the west end and slate at the east end. The slate is overlaid with a harder rock, and also rises to the west. In driving the heading the slate separated from this harder rock, causing a large increase in the height of the heading, which at the highest point reaches a height of 17 ft. above the tunnel roof, the tunnel having a total height of 37 ft. above bottom grade. This condition obtained for about 400 ft. at the eastern end. As it was not considered expedient to place all the material excavated into the west embankment much of it had to be wasted.

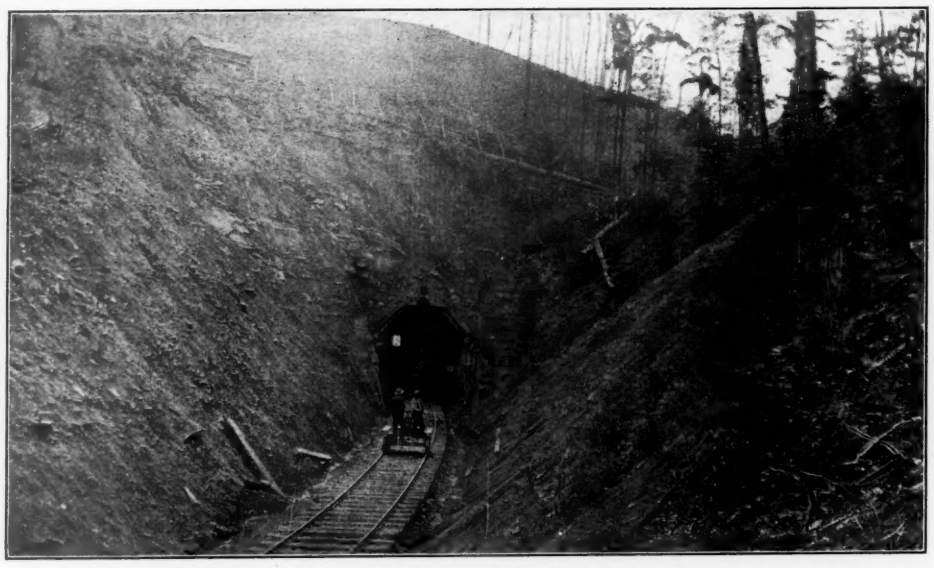


Fig. 7.—East Portal, Holbrook Tunnel.

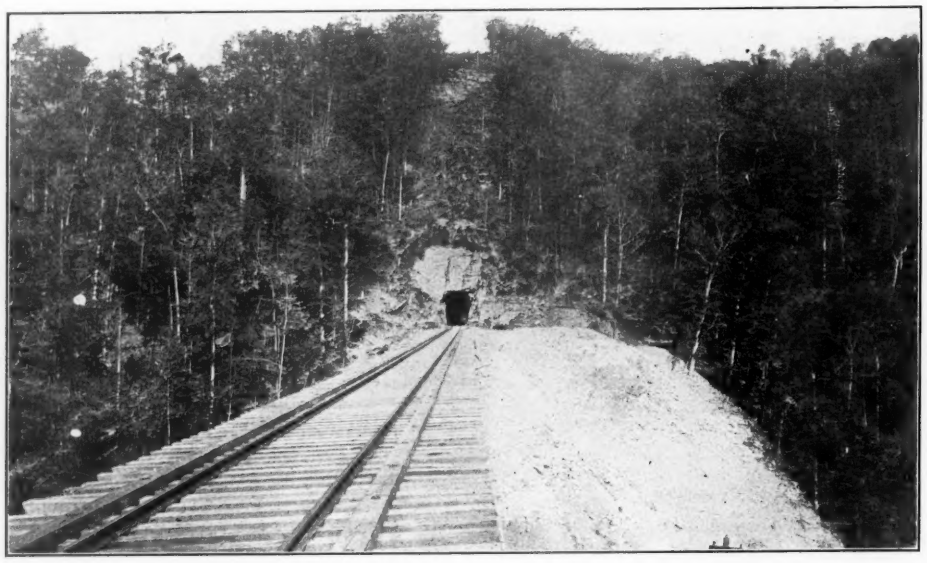


Fig. 8.—West Portal, Holbrook Tunnel.

The last tunnel on the line is named the Little Tom, being driven through the divide between the waters of Little Tom creek and Bull run. The material through which the tunnel was driven was slate and sandstone, the former at the west end and the latter at the east end. The sandstone forms the top and bottom of the numerous coal seams found in the neighborhood. The strata lie approximately level and vary from a few inches to several feet in thickness. Portions of the rock disintegrated upon exposure to the air, necessitating timbering at certain points. After the track was laid through the tunnel, the roof of that portion of the tunnel not timbered gave evidence of failure, large slabs 6 in. or more in thickness falling at frequent intervals. To prevent further falls a modification of the standard timbering, minus the posts was used, the arch timbers resting against shoulders in the rock.

On the straight tunnels the section shown by Fig. 12 was used on the portion requiring no timbering. This rock section was 13 ft. wide at the bottom, 15 ft. wide at the spring line, and 20 ft. high from the sub-grade to the roof. The area of the section is 263.66 sq. ft., equivalent to 9.765 cu. yds. per lin. ft. Where timbering was necessary the section shown by Fig. 11 was used. This section has an area of 314.16 sq. ft., or 11,635 cu. yds. per lin. ft. The uprights are 8 x 12 in., spaced 3 ft. 6 in. centers. The sills are 6 x 12 in. keyed or wedged up on 3 in. blocks. The wall plates are 12 x 12 in. timbers, while the arch blocks are 10 x 12 in. The lagging is 3 in. stuff. Part of the timbering was done by the company's force, and the remainder by contract, at $60 per M. B. M. Much of the timber has lately been replaced by a masonry lining of brick.

The excavation price for tunnel excavation was $3.50 per cu. yd., except for Little Bull tunnel, where it was $3.25. In addition $1.50 per cu. yd. was paid for slips and falls. The following table shows the quantities of the regular, as well as those of the falls and slips, and percentage of latter.

		Excavation in yds.		Percentage.
Name of tunnel.	Miles from Graham.	Regular.	Falls and Slides.	Falls and Slides.
Creagan	79	11,287	3,850	34
Big Bull	82	20,835	4,786	.23
Little Bull	82	4,498	1,032	.23
Holbrook	83	17,318	5,477	.32
Little Tom	87	21,430	5,322	.25

The price for packing behind the lagging was also $1.50 per cu. yd. The cost of the tunnels did not vary much for $60 per lin. ft.

Another interesting feature of this location is the four large trestles between Holbrook and Little Tom tunnels originally built of timber. The following table shows some of the characteristics of these trestles.

No. and Name.	Section.	Length.	Height.	Ft. B. M.
56—Hamilton	86	520	126	231,716
57—Kennedy	87	658	147	368,469
58—Little Lawson	87	495	120	241,515
59—Big Lawson	88	646	150	366,451

The contract price per M. ft. B. M. of these trestles erected was $30.00, plus an allowance of $3.00. This also included the bolts, spikes and washers. The masonry footings were paid for separately. The total cost of these 10 miles, exclusive of track, was about $837,000, as shown in the concluding table:

	Cost.
Section 80	$29,000
Section 81	121,000
Section 82	51,000
Section 83	47,000
Section 84	44,000
Section 85	167,000
Section 86	115,000
Section 87	47,000
Section 88	63,000
Section 89	153,000
	$837,000

Joint Meeting of the British and American Mechanical Engineers.

A joint meeting of the American Society of Mechanical Engineers and of the Institution of Mechanical Engineers of Great Britain was held in Chicago May 31st to June 3rd inclusive. It was probably the largest meeting of mechanical engineers that has ever been held, there being about 100 members of the British society and 550 members of the American society in attendance. The total registration of members and guests was 933. Two evening and three morning sessions were held, the former being in the Music Hall of the Fine Arts Building, two of the latter in the Auditorium Hotel and the third and last at Lewis Institute.

In the absence of Mayor Harrison, City Controller McGann welcomed the two bodies to the city. His address was responded to briefly by President Swasey, of the American society, and President Wicksteed, of the British society. No business was transacted at this first session, which was held Tuesday evening. On Wednesday morning, June 1st, at the first professional session, Secretary Hutton of the American society, reported at some length on the progress of the Carnegie union engineering building project in New York. The competition for the design of the building will close June 15th, and it is expected that preliminary work for the erection of the structure will begin shortly after.

Owing to the large number of papers presented at this meeting and the shortness of the sessions, oral discussion of the papers was for the most part brief, and not very general. The list of subjects was printed last week. Following Mr. Hutton's remarks three papers

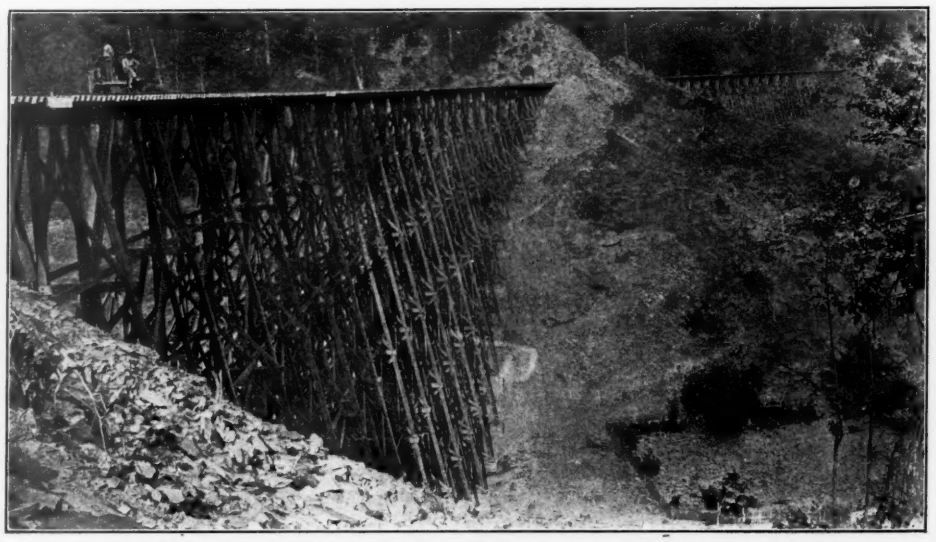


Fig. 13.—Big and Little Lawson Trestles.

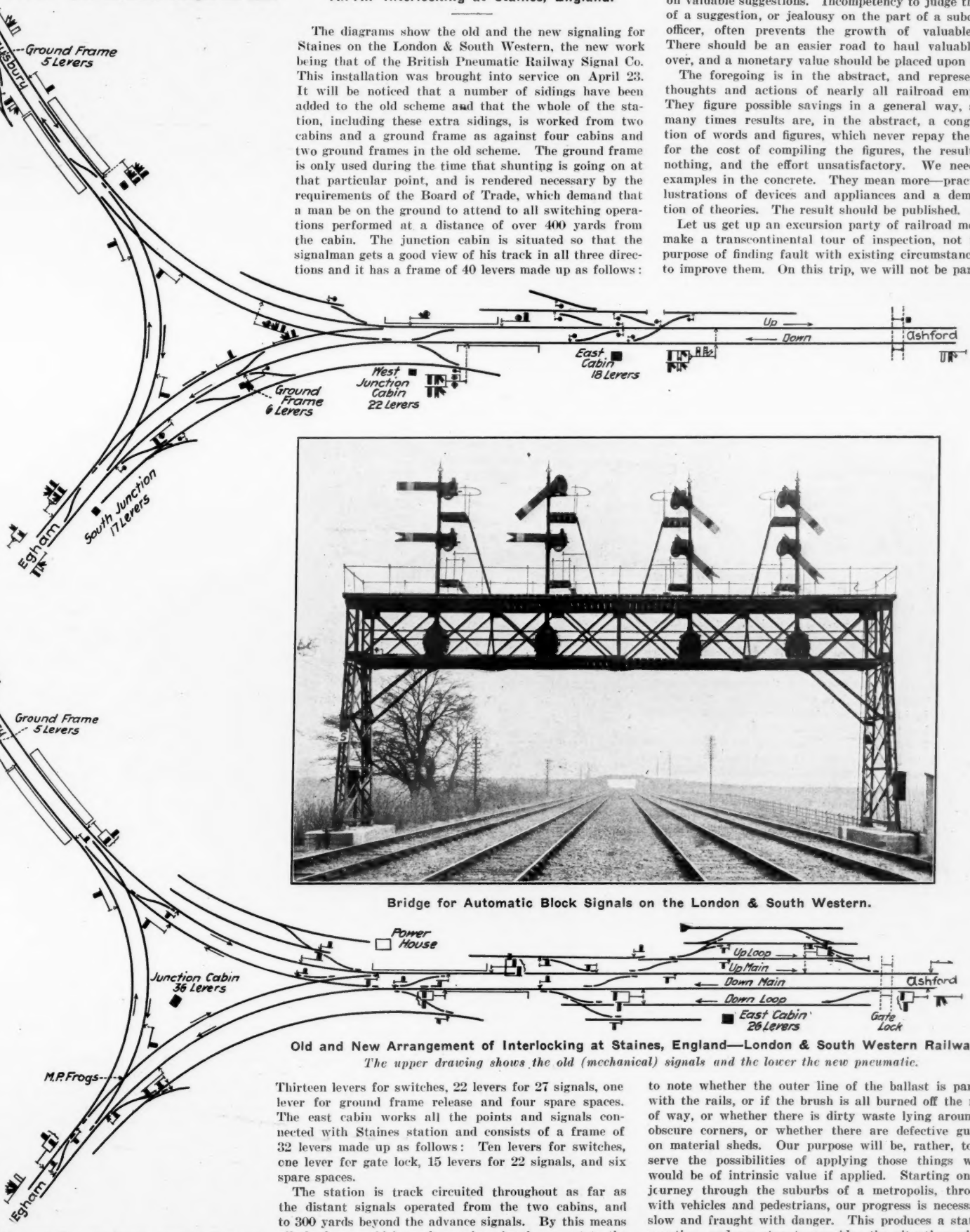
were considered, being Mr. Emerson's paper on "The Wage Problem" and the papers of Messrs. Watson and Russell, of the British society, on town refuse destruction. At the evening session the four turbine papers and Mr. C. V. Kerr's paper on the kindred subject of "The Potential Efficiency of Prime Movers" were discussed jointly. As denoted by these several papers, considerable attention was bestowed upon the steam turbine at this convention, the interest being further heightened by a visit to the Fisk Street station of the Commonwealth Electric Company, containing some 5,000-k.w. Curtis turbines. The discussion brought out some interesting points regarding condenser practice for turbines. The opinion was expressed that the economical vacuum limit is 28 in., for although higher vacuua produce an appreciable increase in efficiency, the first cost of apparatus is also considerably increased and it was questioned whether the gain in economy justified the higher first cost.

On Thursday five papers were presented, the first dealing with power plants for tall office buildings. These papers covered practice in New York City exclusively. Of the other three papers, one was by a member of the British society, on the "Middlesbrough Dock Electric and Hydraulic Power Plant" of the North Eastern Railway of England. Six papers were presented at the Friday morning session at Lewis Institute, three of which were on locomotive testing. They were not discussed orally. At the close of this session Judge Kohlsaat, of the United States Court, President of the Board of Directors of Lewis Institute, addressed the meeting.

A liberal programme of entertainment was provided by the local committee of the American Society of Mechanical Engineers, the principal features of which were given in the programme printed last week.

All-Air Interlocking at Staines, England.

The diagrams show the old and the new signaling for Staines on the London & South Western, the new work being that of the British Pneumatic Railway Signal Co. This installation was brought into service on April 23. It will be noticed that a number of sidings have been added to the old scheme and that the whole of the station, including these extra sidings, is worked from two cabins and a ground frame as against four cabins and two ground frames in the old scheme. The ground frame is only used during the time that shunting is going on at that particular point, and is rendered necessary by the requirements of the Board of Trade, which demand that a man be on the ground to attend to all switching operations performed at a distance of over 400 yards from the cabin. The junction cabin is situated so that the signalman gets a good view of his track in all three directions and it has a frame of 40 levers made up as follows: Thirteen levers for switches, 22 levers for 27 signals, one lever for ground frame release and four spare spaces. The east cabin works all the points and signals connected with Staines station and consists of a frame of 32 levers made up as follows: Ten levers for switches, one lever for gate lock, 15 levers for 22 signals, and six spare spaces.



Old and New Arrangement of Interlocking at Staines, England—London & South Western Railway.
The upper drawing shows the old (mechanical) signals and the lower the new pneumatic.

Bridge for Automatic Block Signals on the London & South Western.

The station is track circuited throughout as far as the distant signals operated from the two cabins, and to 300 yards beyond the advance signals. By this means all the levers which work running signals are set to the stop position by the train. In the track circuiting of this station insulated tie plates and force rods are used. In no part of the station is there sufficient neutral track for an engine to stand on without holding the signal commanding the road at danger. To provide against the possibility of cars with Mansell wheels standing on the platform road and not holding the signals commanding the section in which they are standing, switches have been provided by which the track circuit is broken.

With these drawings our correspondent sends a perspective of one of the numerous signal bridges lately put up on the line of the London & South Western for the automatic block signals made by the British Pneumatic.

The Loose Ends in the Motive Power Department.*

Employees frequently report the result of their observation and study to their immediate superior, and, I regret to say, little or no attention is given to them. Seventy-five per cent. of such reports are never again heard of, and the other 25 per cent. are transmitted to the next in authority, where the same proportions stop, and so on, until comparatively few of the many valuable suggestions from experts in humble positions ever reach the general officers who have authority to authorize action to be taken on valuable suggestions. Incompetency to judge the value of a suggestion, or jealousy on the part of a subordinate officer, often prevents the growth of valuable ideas There should be an easier road to haul valuable ideas over, and a monetary value should be placed upon them.

The foregoing is in the abstract, and represents the thoughts and actions of nearly all railroad employees. They figure possible savings in a general way, so that many times results are, in the abstract, a conglomeration of words and figures, which never repay the writer for the cost of compiling the figures, the result being nothing, and the effort unsatisfactory. We need more examples in the concrete. They mean more—practical illustrations of devices and appliances and a demonstration of theories. The result should be published.

Let us get up an excursion party of railroad men, and make a transcontinental tour of inspection, not for the purpose of finding fault with existing circumstances, but to improve them. On this trip, we will not be particular to note whether the outer line of the ballast is parallel with the rails, or if the brush is all burned off the right of way, or whether there is dirty waste lying around in obscure corners, or whether there are defective gutters on material sheds. Our purpose will be, rather, to observe the possibilities of applying those things which would be of intrinsic value if applied. Starting on our journey through the suburbs of a metropolis, thronged with vehicles and pedestrians, our progress is necessarily slow and fraught with danger. This produces a state of vexation, and we stop to consider the situation with a view of determining what might be done to prevent the delay and loss to the company. We find six flagmen imperfectly protecting the crossings, and their wages aggregate $9 per day. One man in a tower can operate pneumatic gates at a cost of $3 per day, and there will be a saving of $6 a day to the company or a sum that will pay six per cent. on the cost of a plant worth $36,500. Would it pay? Many companies think so, while others say that they cannot afford it. Is the latter true?

Traveling on, we visit the shops of a small road owning

*Extract from a paper read by W. L. Kellogg, Master Mechanic, Missouri Pacific, before the Pacific Coast Railway Club.

100 engines. We are informed by the officials in charge that one-third of this power is not up to date, but they cannot afford to purchase new. Let us consider the matter and see if they can or cannot afford such expenditure. Their performance sheet shows that each of these engines cost two cents per mile more than better designed engines hauling greater tonnage over the same territory. Two cents per mile in itself is a small item, and we view it with complacency. It will not even buy a sack of peanuts or a pound of waste, but when we consider that this poor class of power annually makes about one and three-quarter millions miles, the two cents per mile assume greater proportions, and when we take into account the sum of $35,000 as a dead loss every year, we are unable to concur in the opinion of these officials, that they cannot afford to purchase new power. It is safe to say that every large railroad in the country has hundreds of such engines, many of which, all things considered, are run at a greater loss than two times two cents per mile. When there is a difference of two or more cents per mile in the cost of operating a locomotive, there is something radically wrong, and this difference will buy some new power; it will purchase the best skilled labor in the market; it will buy improved machinery; it will furnish the best quality of coal, or a water that will not ruin the boilers. This discrepancy should not exist, but if it does, some one is at fault; some one needs retiring, that room can be made for a more progressive man. We should remember that the dividends are the mills on miles run—our dividends, as well as the stock owners'.

At another point we viewed a well-equipped coal-chute. There was the usual incline and covered chute, but it was operated differently. We did not see the customary switch engine taking run after run up the incline, and fail, then cut off two cars, and run the balance up, while three switchmen stood at the bottom swearing, because another under more favorable conditions, once put up the number of cars he first failed with. At this station two men are constantly employed, and they unload from hopper bottom cars all the coal used. They use a donkey engine and a cable to haul the loaded cars up and let the empties down. These two men attend to the dumping of chutes and accounting for the coal, and the cost of handling is six cents per ton less than at the average coaling station. Six cents per ton of itself seems to us a small thing, but let us consider if it is worth saving. Many railroad systems use 500,000 tons of coal per annum, and six cents saved on the handling of this quantity will amount to $30,000. or the interest on $500,000 at six per cent. for one year. This amount would equip the largest system with modern coaling stations. In addition, we will make the assertion, without fear of successful contradiction, that the consequential cost of coaling engines from the ground, or from bins with buckets and cranes—in considering the deleterious actions of the elements on the coal; the mixing it with sand and cinders in getting it from the ground; the burning of a ton of coal on many engines while waiting turn to have six shoveled on, and the average of from one to two hours for engines held out in the yard when they should be in the house receiving necessary repairs—will be not less than 20 cents each on every ton of coal consumed. Furthermore, it is possible for railroads to contract the coaling of engines at present prices for five years to men who would make the improvements necessary and at the end of that period make the company a present of the plant. So we conclude that if private speculators can afford to put up modern coaling stations for the difference in cost per ton, railroads can better afford it when many other consequential savings are possible.

We next visited the shops of a leading line, and were surprised to find that, although their rolling stock and equipment were first class, and that they had some superb limited trains, their shops were inadequate, badly arranged, having antiquated machinery, and the general surroundings stamped with the stencil of 20 years ago. At that time they were considered well arranged, and up to the present have rested on their laurels of two decades past and gone, to strengthen the assumption that they were still up to date. Let us make a few observations. On entering, we observe two men operating single-ended axle lathes, and we figure $2.50 per day lost. We note there are neither drop pits nor traveling cranes, and we put down $10 per day lost. The remainder of the machinery examined convinced us that there was a further loss of $9 a day, by continuing in service a number of machines which might have been replaced with something more modern. We found the hand tools in the tool room in poor condition. Men carried tallow candles and walked 100 yards to the store room every time they required a new one. After leaving the shops and noting the many inconveniences we tabulated the apparent losses and found a total of $57 per day. New shops have been planned for years. Each resident engineer had submitted plans, but it was never considered of sufficient importance to warrant the expenditure. Let us see; $57 per day, in one year's time, will amount to $20,805, which is sufficient to pay the interest on a sum that will build and equip a modern shop, and the daily losses saved will pay the interest on the amount. Would it pay?

At a busy division point, where a turntable is required to turn locomotives, it is safe to say that it takes the time of two men, day and night, to operate the table, at a cost of at least $8 per day. This will amount to $240 per month and $2,888 per year. If this expense can be reduced one-half, or still more, by having a hostler operate the table, it would produce a saving of $1,440 per year which, at six per cent., represents an investment of $24,000, enough to equip all the tables on a trunk line with power to turn them. These calculations, not including cost of power, which is a secondary consideration, are made possible with the various kinds of motors to be had.

Another point which came under our notice was the manner of washing boilers, and in only one instance did we think any degree of perfection was reached. This boiler washing plant seemed complete in all of its details. A 2-in. pipe, placed overhead, led entirely around the house, and into this steam from all locomotives was blown and carried to a condenser. Steam from other sources exhausted into this pipe. The water was filtered and led to a 10,000-gallon hot well. The hot water from the jet condenser also falls into this hot well, and there is sufficient water to wash out and fill up all locomotive boilers and furnish the feed water for shop boilers. With this system, having connections for locomotive domes, it is possible to transmit steam from live engines to dead ones. This in itself will make it possible to get up steam in a short time, and it will greatly reduce the expense of firing up. In an ordinary shop 50,000 gallons of hot water are used daily and the cost of raising the temperature from 60 to 200 degrees is approximately $25 per day. This plant not only saves $25 a day by condensing the exhaust steam, but it purifies the water, reduces the time required to get engines ready, and prevents the stay-bolts from breaking. The direct saving alone will pay the interest on an investment of $152,000. Such a plant will cost about $300, and very little for maintenance. Would it pay? It certainly would, but there are very few such plants to be found on our so-called up-to-date railroads.

We found very few railroads where the officials were thoroughly alive to the importance of the fuel question. Some officers could talk for hours about minor items of expense, and tell how much they had saved, but had done little toward reducing the cost of fuel. The best authorities tell that but ten per cent. of the fuel consumed by locomotives is effective in pulling cars. When we consider that from 40 to 60 per cent. of the cost of operating locomotives is spent for fuel, we marvel much. We have heard of private individuals, experts in their line, offering to equip engines with coal-saving devices, and devote their entire time to this purpose, receiving for their pay a small percentage of the savings. It occurs to us that railroad companies should use more energy in this direction.

There is also the question of feed-water for our locomotives. Millions of dollars are expended annually in renewing flues and fire-boxes on account of poor water; every conceivable mixture of boiler compound has been tried, without any substantial benefit. A system of reservoirs to hold rain water, where good water cannot be obtained, is the only sure remedy.

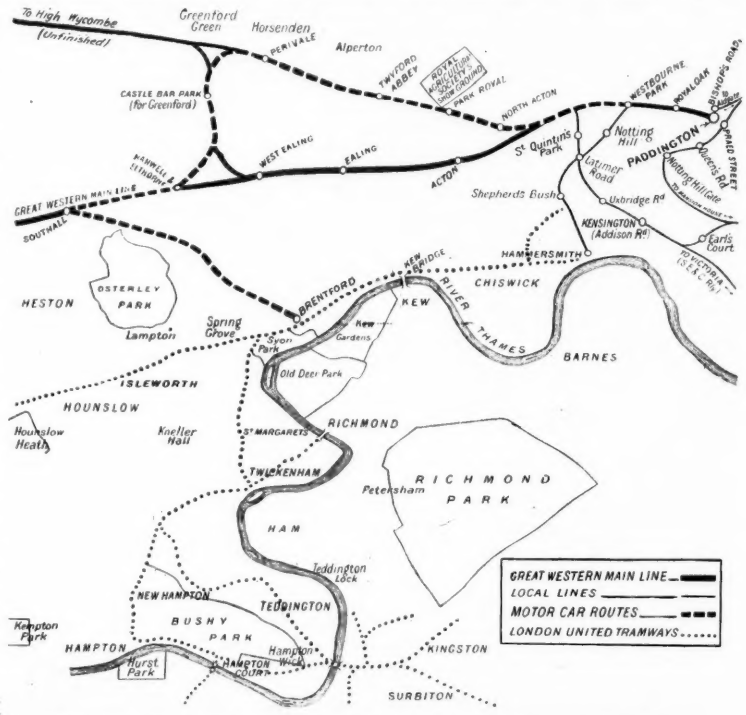
In the mechanical line of locomotive equipment, there are many devices and attachments that are important, if we compute on the saving of the better and the losses of the poorer. One of the most important that will bear investigation is the style and size of the injector used. It is safe to assume that the question of boiler feed is the most important factor in connection with economy of fuel that we have to contend with. Are your injectors of the best design and size suitable to the requirements? Are they lifting injectors, capable of feeding warm water with the greatest range necessary to varying conditions, or are they non-lifting, out of reach and sight of the operator, which, of itself, is not conducive to the best results that should be attained, if we figure on the saving of the black diamonds, which we feed into the capacious mouth of the modern battleship? According to data compiled from tests made on some of the most important trunk lines, locomotives equipped with ancient injectors cost enough more for fuel each 5,000 miles run to purchase modern injectors. Would it pay?

The illustrations might be multiplied by hundreds of thousands. They are things that are known to exist, and are daily and weekly commented upon by those who are intimately connected with the operation and maintenance of railroads; while the exact conditions are not known, it is usually understood that the abstract may become concrete with but little further investigation. But why the original condition, and why is the remedy delayed? Is it the fault of patient or physician? Our answer would be that it is neither of these but the lack of means to procure the necessary drugs. In most cases our methods and avenues of communication and our censors of utterance are largely responsible. Departmental lines, over which we fear to step, are too closely drawn for our common good. The lack of expression and praise of a duty well performed, which would influence further effort, as well as the checking up of perverse methods, would be sure to quicken the senses of those responsible for their inattention, and are equally important.

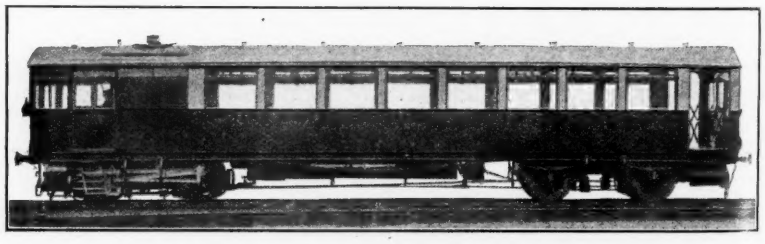
Railroad Motor Coaches Near London.

BY W. B. PALEY.

Few lines in Great Britain have displayed so much energy of late years as the Great Western, and the newest manifestation of this takes the form of "rail motor cars"; passenger vehicles with an engine and boiler in a compartment at one end. The *Railroad Gazette* has more than once mentioned the fact that experiments in this direction are being made by several British railroad companies. So far back as October last the Great Western put one in service between the small towns of Chalford, Stroud and Stonehouse, in Gloucestershire, on a



Great Western Main Line and Motor Car Routes near London.



Rail Motor Car Used by the Great Western.

portion of the old route from London to South Wales, now largely superseded by the Severn Tunnel. A number of mills and factories, close together in a narrow valley, made this section of seven or eight miles peculiarly suitable for an attempt to realize the advantages of a tramway upon a railroad not overburdened with traffic. The experiment answered so admirably that it has been determined to see if it can be made to raise a traffic upon a new piece of line in a hitherto closed district very near London. The line in question forms the four miles nearest London of a second route to Oxford via High Wycombe direct, and a spur line about two miles, connecting this with the old main line of 1838-41. Further than the point of junction, at Greenford, of these two sections, the new secondary main line is not yet open, nor will it be for some time to come. All the villages near the line are of the smallest kind and much more primitive than most Londoners have any idea of. Until lately the district, though extremely pretty, has remained practically shut up, but recently the Metropolitan and the Metropolitan District Railways, with more foresight than the great trunk lines, have broken into this preserve and opened it out; population is flowing in, and a few years will see it a favorite residential neighborhood. To get a share of this traffic the Great Western is now running a motor-coach service, started on May 1, and intended to further the development which others began.

As ordinary suburban trains and costly stations would be absolutely unprofitable for some years, the motor-coach system suggested itself as a way to meet this rather unusual case. Four stations, or "halts," of an inexpensive kind—in fact, they are merely wooden platforms with a little waiting shed of corrugated iron on each—have been established, a larger permanent station to serve an agri-

cultural show-yard only open for a week every year, being also utilized. The coach runs to and fro all day, starting from Westbourne Park station, a mile out of Paddington, leaving the main line 2¼ miles further on, rejoining it at Hanwell, and running down to Southall, a trip of 10 miles made in 30 minutes with five stops. On Sundays it runs to and from Paddington.

Fifty-two seats are provided, most of them along the sides, but eight on each hand, in the middle, face the ends. All are covered with rattan; the roof is semi-circular and of ample height. It carries six double-burner gas-lamps, and has two stout brass rods for holding on by, with leather loops for those who cannot quite reach them. Eight large windows on each side give a great idea of spaciousness and light. The passenger compartment is 39 ft. long. At the end nearest the engine is a side door of the ordinary British railroad type, to be used for entrance only. Passengers leaving step out at the other end into a covered platform 4 ft. long, having doorways on each side defended by a system of lifting bars. On this platform, protected in front by three glass windows, travels the engine-driver when the car is running with that end first. At present two other men are generally with him, though they can go inside when they like. One of these is the guard, who issues tickets to those who get in and opens the door to admit them. The other man sees the people out and collects their tickets, no staff being kept at any of the five new stations.

The regulator is nearly in the center, hanging down. A bell-crank at the top of it works a rod that goes down through a tube to another rod underneath, which communicates with the engine. On the driver's left is a pull-down brass rod, working the whistle through a chain that runs in one of the handles the people hold on by inside the coach. To the right is the handle (a removable spanner) of the vacuum brake, with the gage and the pipe to admit air when stopping. An ordinary hand-brake is also fitted and seems to be generally used in conjunction with the other. There is a small door leading into the engine compartment, for use in case of emergency, but ordinarily it is kept locked. The boiler is of the vertical type, with a cone top, and has, besides a grate area of 11.48 sq. ft., very ample heating surface, 477 short tubes, 1⅛ in. in diameter, giving 625.58 ft., and the fire-box 44.34 more, or practically 670 in all. For cylinders only 12 x 16 this may seem unnecessarily large, when it is remembered that there are hundreds of main-line passenger engines in this country with only about 50 per cent. more for cylinders of treble the capacity. It has wisely been judged advisable, however, to have an ample margin of power, in view of possible developments of this class of traffic. As it is, a five compartment coach of the ordinary kind could be taken as a "trailer," the platforms being long enough. In the engine compartment are the coal boxes, brake and whistle gear, etc., the end having three glass windows, with the two side ones set somewhat at an angle, the same as the other end of the vehicle. There are two bogies, the one under the boiler having the cylinders bolted on horizontally, and spoke wheels with cast-steel centers. These wheels are 8½ ft. apart at the centers, and 44 in. in diameter.

The wheels of the other bogie are only 8½ ft. apart, of the usual Mansell's wood disc construction. Walschaert's gear is used, with balanced side valves on the top of the cylinders. The funnel has a neat brass cap around the top and does not touch the roof by 3 or 4 inches, a projecting collar all around, a little higher up, serving to keep out rain while admitting fresh air. The motor compartment being 12 ft. 9 in. long is pretty spacious, and gives ample room to get around the boiler. The fireman, of course, remains in it whichever way the coach is traveling. Water tanks to hold 450 gallons, and the gas and brake cylinders, are under the body of the coach, which is painted in the Great Western colors of cream white above the center line and green below. The vehicles were designed by Mr. G. J. Churchward, the company's Locomotive, Carriage and Wagon Superintendent at the Swindon Works, and are very handsome in appearance. The running is very smoth, with a shade more vibration when going engine first, but there is not enough to incommode the most delicate person. About 30 miles an hour is often reached, which is quite fast enough, as coupling-rods 8½ ft. long on such little wheels move pretty fast then, and are probably the cause of what little vibration there is. As will be gathered from what has been said, there is only one "class," the same as in a tram-car, and the local tickets issued by the guard are similar to those used on most British tramways. Passengers are requested not to smoke, nor to spit, but if the traffic increases much these most reasonable requirements will be difficult to carry out, the British workmen being decidedly of opinion that he ought to do both, especially the latter, whenever and wherever he choses.

Simultaneously with the service just mentioned another motor coach was put on the old branch from Southall to Brentford. This, though ending there, is a double line and was chiefly made to compete with the Grand Junction Canal, which there joins the Thames. There are extensive wharves and sidings and at one time a considerable exchange of river traffic in coal, timber, etc., was done. There is little now, and of passenger traffic still less, Brentford having shorter railroad routes to London. However, the whole district has much increased in population of late years and is being greatly opened out by electric tramways. A service every half hour on week days, once an hour on Sundays, is running, with fair prospect of success. Anyhow the cost must be less than that of the engine and three or four coaches that used to run to and fro, at such long intervals that it was almost useless. There are no intermediate stations on this branch, which is slightly over three miles long, with running time of eight minutes. Except for the first mile out of Southall both roads are still laid with the bridge rails and longitudinal sleepers of old-fashioned Great Western practice. The "mixed" or broad and narrow gages interlaced, were at one time laid on this branch, which was opened in July, 1859, the former surviving till 1875. It is worth while to have a run over this and note the difference, and inferiority of it, compared to the chair road. On the line is a curious bit of engineering, where the canal crosses diagonally in a built-up cast-iron trough, a high road giving over the latter at the same point in a different direction, while rail and road level are only 34 ft. apart.

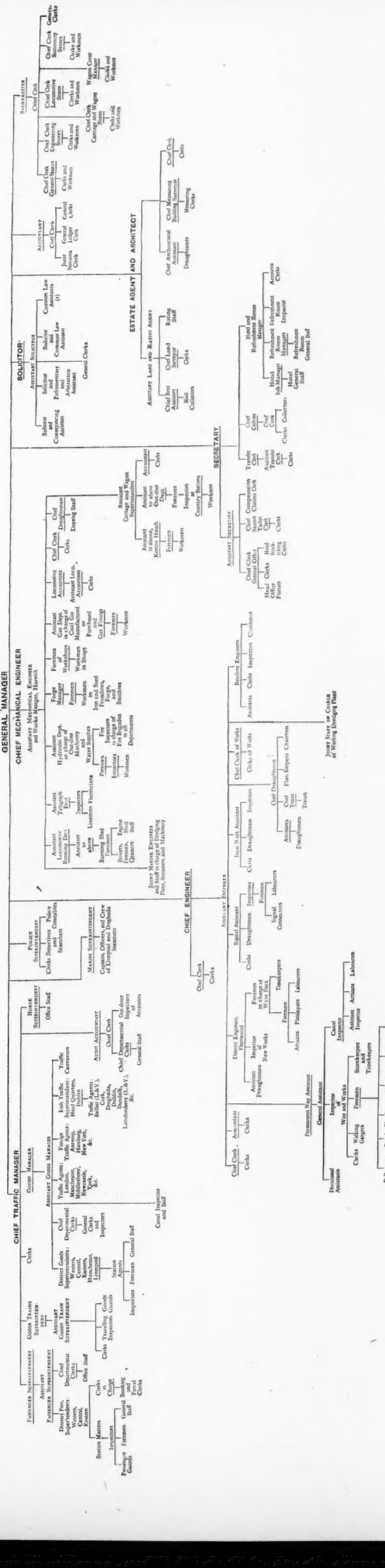
Organization of the Lancashire & Yorkshire.

The accompanying diagram of a British railroad organization is reproduced in full, by way of showing how completely the departmental method is adhered to. The first thing likely to strike the American observer is the conspicuous absence of the division superintendent in charge of general operation. The British "district" is about the same as the American "division," but the separation of freight from passenger traffic is carried beyond the "district," which, in America, would quite unexceptionally be the operating unit, whether the organization were divisional or departmental. The Chief Traffic Manager, who, in this country, would be called General Superintendent, is the only operating officer below the General Manager who has control of both classes of traffic.

It will also be seen that there is no officer who exactly corresponds to the President of an American road. The President of a British railroad, often titled, and seldom possessed of active railroad experience, figures mainly as the presiding officer at directors' meetings: the General Manager is the active head of the road. Questions of ultimate policy, about which an American President is expected to be the chief authority, are usually handled in England by sub-committees of directors, who report to the main body at the annual meeting.

Further comment on this organization will be found in the editorial column.

ORGANIZATION OF THE LANCASHIRE & YORKSHIRE, MARCH, 1904.



Foreign Railroad Notes.

The Prussian State Railroads during their fiscal year ending with March last earned $24,013,962 more than during the previous year; a 7 per cent. increase. This is nearly $30,000,000 more than was estimated when the year began, there having been meanwhile a marked improvement in business in the country.

At the request of the Austrian locomotive works, the Minister of Railroads has directed that hereafter in all important railroad constructions, the contractors be required to order all tools, machinery, vehicles, etc., from Austrian works exclusively, if such articles are produced in that country and can be supplied in time for the execution of contracts without delay.

Locomotives for the United Railroads of Yucatan.

The Baldwin Locomotive Works has built seven ten-wheel locomotives, one Atlantic type locomotive, and one six-wheel switching locomotive for the United Railroads of Yucatan. The Atlantic-type locomotive (Fig. 1) is standard gage and weighs 120,835 lbs., with 61,825 lbs. on the drivers, the driving axle load being only 30,912 lbs. The cylinders are 18 in. x 24 in., and the drivers are 68 in. in diameter. The boiler carries a working pressure of 180 lbs., and contains 1,982 sq. ft. of heating surface with 134 sq. ft., or 6.8 per cent. in the fire-box. The grate area is 24.8 sq. ft. The boiler contains 244 2-in. tubes 14 ft. 7½ in. long. The fuel is soft coal.

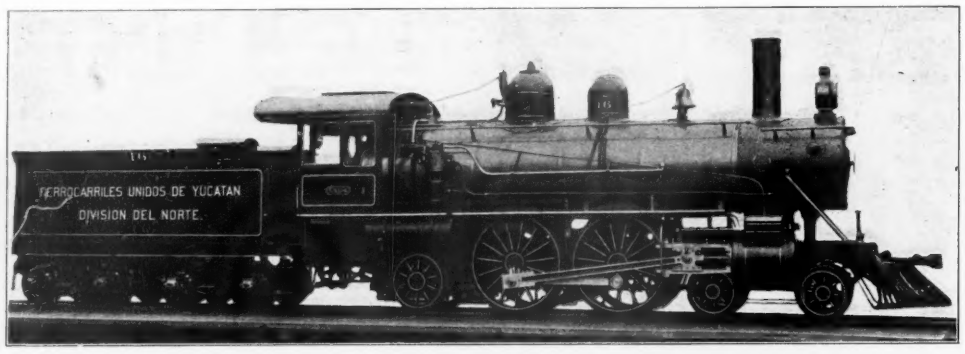


Fig. 1.—Atlantic-Type (4-4-2) Locomotive—United Railroads of Yucatan.

This engine is to be used on the northern division of the road.

The ten-wheel locomotive (Fig. 2) is 3 ft. gage, and weighs about 73,000 lbs., with about 57,000 lbs. on the drivers, the driving axle load being only 19,000 lbs. The cylinders are 15 in. x 20 in., and the drivers are 44 in. in diameter. The boiler carries a working pressure of 160 lbs., and contains 991.5 sq. ft. with 78.5 sq. ft., or 7.9 per cent. in the fire-box. The grate area is 11.9 sq. ft. The boiler has 161 2-in. tubes, 10 ft. 11 in. long. The fuel is soft coal.

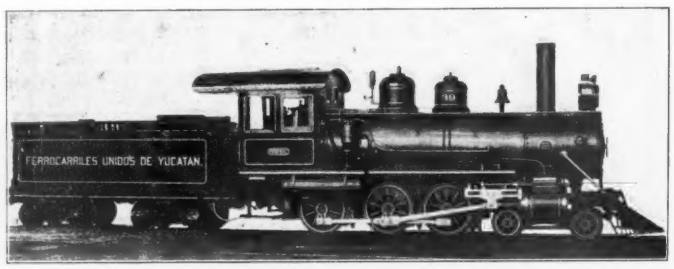


Fig. 2.—Narrow Gage Ten-wheel (4-6-0) Locomotive—United Railroads of Yucatan.

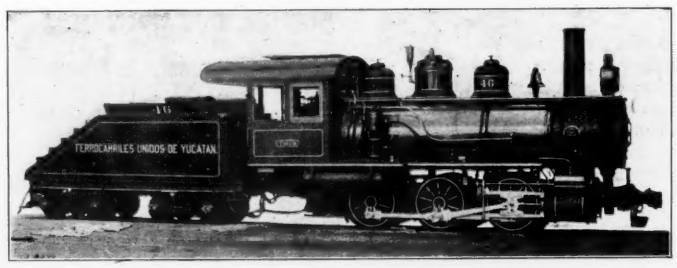


Fig. 3.—Narrow Gage Six-wheel (0-6-0) Switching Locomotive—United Railroads of Yucatan.

The 6-wheel switching locomotive (Fig. 3) is 3 ft. gage and weighs 64,000 lbs., the axle load being only about 21,300 lbs. The cylinders are 16 in. x 20 in., and the drivers are 44 in. in diameter. The boiler carries a working pressure of 160 lbs., and contains 897.3 sq. ft. of heating surface with 72.3 sq. ft., or about 8 per cent., in the fire-box. The grate area is 13.4 sq. ft. The fuel is soft coal.

History of Timber Treatment.*

Active progress in timber preservation dates from the year 1832. During this and the ten following years, the processes of Kyan, Bethell, Burnett and Boucherie, each giving his name to a process still known thereby, as well as the treatment patented by Margery, were introduced in England and France, and shortly put into very general use. Bethell, Burnett and Margery differed principally and as applied later, entirely, in the chemicals used. Kyan advocated the bi-chloride of mercury or corrosive sublimate; Bethell, various substances, including the dead oil of coal tar; Burnett, chloride of zinc; Margery, sulphate of copper. Kyanizing was performed in open masonry pits without pressure, because of the corrosive effect of the mercury on metal. Burnett's and Margery's patents show that the chemical was intended to be introduced into the wood by soaking; but this in practice was soon abandoned by them and injection by pressure substituted.

The Bethell patent related more particularly to the *method* of treatment. This consisted of the use of closed vessels to contain the timber, in which first a vacuum was produced, the timber being partially surrounded by the chemicals, and being preferably placed in an upright position; then fully surrounded by the chemicals and pressure applied to force it into the wood. Bethell mentions the dead oil of coal tar as one of the preservatives which can be used. Two years prior to this, a patent was issued to Franz Mill for a treatment consisting of a preliminary heating in a closed vessel, then the admission of the vapor of the first distillate from coal tar, followed by soaking in this same distillate which he called eupion—the object of all of which was to season the wood and prepare it for the next treatment which was the soaking in the second distillate of coal tar, or what he called Kreosot. This treatment has never been followed in practice as it only wastes the first distillate; and Bethell's method of treatment using the dead oil, which is the second distillate of coal tar, called by Moll, Kreosot, supplanted it. Presumably the name of Creosoting came from Moll's suggestion, although it is a misnomer. Creosote properly is the name given to one of the products of the destructive distillation of wood; and none of this material is secured in the distillation of coal tar. Several of the constituents of both are identical, however, and the name was early given to the dead oil of coal tar.

The name at any rate has stuck, and while the disposition to-day is to discourage the use of the term Creosote for the material, using in preference the term "dead oil of coal tar," there is no objection to its use as a name for the treatment.

The Boucherie method differed radically from the others in the method of injecting the chemical, which was generally sulphate of copper. At first, Boucherie applied his chemical by means of vital suction. A tree was stripped of its branches, excepting those at the extreme top, a cut made around the tree near the bottom, through the sap wood, the cut covered by a cloth or other means, and the solution of the salt fed to the open cut. The tree by its own suction would draw the preservative up through its entire length in a surprisingly short time. It is reported that in poplar it would rise 95 ft. in seven days, and that a good sized tree would absorb from 200 to 300 litres.

To follow this method on a commercial scale evidently was difficult, so it was modified by substituting for vital suction, hydraulic pressure. The trees were cut into logs, a cap applied to one end and connected to a supply of the preservative under pressure, resulting in its being forced through the log, driving out sap and water ahead of it. This process was at one time extensively used in France with good results, and is still used there for the treatment of telegraph poles.

The processes of Kyan and Burnett, especially the latter, were used largely in Europe for many years. Burnettizing is still used to a considerable extent there, especially in Russia. Perhaps the proportion is best expressed in the statement in the 1901 Bulletin of the International Railway Congress, where of 87 railroad managements reporting on ties, 28 used no preservative methods, 38 used creosote, 18 used zinc chloride (Burnettizing), 4 used emulsions of creosote and zinc chloride, 3 used copper sulphate, 1 used brine. This plainly exhibits the recognition of the superiority of creosoting.

The history of treatment in the United States extends about as far back, but the adoption of treatment has not been as general. For this there has been good reason. Our supply of timber being much greater, and the quantities required greater while the cost has been much less, the necessity for the conservatism of the supply and the economy of an expenditure for treatment, has not been sufficiently evident.

The use of zinc chloride or burnettizing dates from 1850, but prior to 1885, the amount of timber so treated was not large. The times were not ripe for it—timber was too cheap and plentiful. There are three men in this country who have done yeoman work for the subject of timber preservation; Mr. O. Chanute, who designed and built several of the early plants and who has been interested in the operation of works for nearly twenty years; Mr. A. A. Robinson, who as Chief Engineer of the Atchison in 1885, after four years of experimental work, had works built in New Mexico; and Mr. Kruttschnitt of the Southern Pacific, who built works at Houston, Texas, in 1887, and who supplemented this good work by having such records kept of the life of the timber so treated, as to give us now something like reliable data as to what may be expected under like conditions.

The progress of burnettizing was comparatively slow. I prepared a paper on this subject in 1899, in which I estimated that during the previous twelve years, about 10,000,000 ties (and burnettizing is used for nothing else) had been treated; and that during 1899 probably 1,500,000 more would be treated. Returns from all the works in the country, now numbering thirty-three, show that in 1903 over 11,000,000 ties were so treated; amounting to about 10 per cent. of the entire tie supply of the country. This figure will be largely exceeded this year, probably reaching 14,000,000.

Creosoting in this country dates from 1865 and has been principally used for the treatment of piles and timber for marine work, to prevent destruction by worms. While a considerable number of ties have been so treated, the expense has been and still is too great, to permit general use for this purpose. Creosoting is by all means the best method of preserving timber known, and wherever the financial conditions are such as to permit the first cost, and where the timber will not be destroyed mechanically regardless of its freedom from decay, there can be no question as to the best treatment to adopt.

When creosoting was introduced into the United States, the Bethell process was followed, consisting of a vacuum followed by the application of the preservative under pressure. This required thoroughly seasoned timber which was an impossible condition here at that time.

I have not yet been able to satisfy myself as to who first proposed seasoning wood by steaming it. Various methods of seasoning were patented. Seely in 1867 was granted a patent on a method of impregnating, consisting of immersing the timber in an iron tank filled with oil, heating it to drive out moisture, replacing the hot oil suddenly with cold oil, whereby it is forced into the wood by condensation. A patent to Hayford in 1872 added to the use of steam for seasoning, the pressure of hot air, to prevent the checking of the timber by the more rapid seasoning of the exterior portions of the wood. This method was advocated and followed by E. R. Andrews in his works at Boston.

S. B. Boulton in 1881 patented a method of seasoning by boiling the wood in the dead oil of coal tar, keeping the pressure in the cylinder below atmosphere, to permit the water to be removed at a lower temperature than 212 degrees. A patent to Messrs. W. G. Curtis and J. D. Isaacs, of the Southern Pacific Railroad, was granted in 1895, covering a process identical with Boulton's, except that they do not use the vacuum during boiling.

The philosophy of both is that as water is vaporized at 212 deg., while the oil does not vaporize under 300 deg., a temperature maintained between these will drive off all the water, which can then be replaced with oil by pressure. Both of these methods have been used in this country with success.

Preservatives for timber are needed to prevent decay and to prevent destruction by marine worms. As under ordinary conditions, untreated timber will resist decay for a considerably longer period than it will a hungry teredo family; and as the amount of timber used on land and in water differed very materially, the use of treated material for marine work made more rapid and general progress. It was soon recognized that no treatment would avail against the teredo and limnoria, except a large injection of dead oil of coal tar. Treating works naturally sprang up to supply the demand, located along the sea coast and gulf line.

These works doing commercial work principally, orders being placed only at the time the material was needed, necessitated the use of green timber and, I believe, few if any of these plants have yard room sufficient to store any considerable supply of material. The use of such green stock results in a much longer treatment being required and in the opinion of some, in inferior work.

From 18 to 20 hours are required to secure the same penetration as is possible with 10 to 12 hours, if air-seasoned material is used, the difference being principally in the length of time spent in steaming the timber.

If the English and Continental practice of long-time seasoning is followed, requiring storage for from 8 to 12 months, the steaming is eliminated entirely and the time of treatment is cut down to about three hours.

The disposition in the west is to adopt air seasoning, as being more economical and better, for treatment by either the creosoting or burnettizing processes. The plants at Somerville, Carbondale and Grenada and those of the Chicago Tie Preserving Co., operate on seasoned

*Extract from a paper by Walter W. Curtis, read before the New York Railroad Club, April 15, 1904.

material entirely. At the Somerville plant there was on the ground seasoning on March 19, 1904:

Ties 859,207
Lumber .....5,533,933 ft. B M.
Piling .....64,560 lineal ft.

The other plants being located farther north and being unable to secure their supplies at all seasons of the year, have so far been unable to secure such large stocks.

The use of creosoted material is now becoming more general for another purpose, which promises a large market. This is for decked trestle bridges, where the ballasted track is carried directly over the structure. Two types of such structures are in use; one where the deck is of solid timber, constituting the stringers and floor of the structure; the other, where separate stringers are used, covered with a 3-in. plank floor.

Mr. E. B. Cushing, Engineer of M. of W. of the Atlantic system of the Southern Pacific, states that road began using solid deck creosoted bridges in 1885. "The first one built was examined recently and found to be in perfect condition. It has never had a dollar's worth of bridge work on it since it was driven, the surfacing, aligning, etc., being done by section men in ordinary process of track work."

The other type of bridge, using stringers and a plank floor, has been in use on the Louisville & Nashville for many years. Mr. R. Montfort, Chief Engineer, recently wrote me:

I cannot state the length of life of creosoted timber where properly treated. I can, however, say, that during the year 1876 the New Orleans, Mobile & Texas used a large quantity of creosoted timber as piling for piers of iron bridges over Chef Menteur, Rigolets, Pearl river, West Pascagoula and East Pascagoula rivers. We are now renewing the superstructures of these bridges; replacing bridges erected by the Phoenix Bridge Company in 1876 with plate girders. At the Great Rigolets we have placed the new superstructure on the piles driven in 1876. Some of these piles are as much as 90 ft. long. At Chef Menteur we used seven piers, each consisting of 16 piles, or a total of 112 piles, not one of which was found defective, although driven 28 years ago. In this climate an untreated pile could not be counted on to last but about seven years, or at the most eight years. The piles at Chef Menteur vary from 75 ft. to 90 ft. in length.

We have on the L. & N. miles and miles of trestle with creosoted stringers that were placed in 1876 and 1878, and are apparently as sound now as they were then. These trestles have, of course, been strengthened by the addition of other stringers so as to carry modern loads.

Mr. Montfort well says, in the face of such results, he cannot tell what is the length of life of properly creosoted material.

The development of the two types of timber deck described above has been due probably to two causes. The solid timber floor costs more and the open stringer form permits the use of both creosoted and uncreosoted material in the same structure. The Chief Engineer of the Southern Pacific, Mr. Hood, has made some tests of creosoted timber, which satisfied him the treatment seriously decreased its transverse strength. He has consequently changed his designs, using creosoted piles and timber below the stringers. These are spaced open and covered with 3-in. plank protected by ¼-in. thickness of prepared roofing and asphalt or with 3-in. plank creosoted.

He expects in this way to secure a long lifed structure with the maximum strength. Before generally accepting Mr. Hood's conclusions as to the effect of creosoting on the strength of timber, opposed as they are to the general understanding on the matter, confirmatory tests will be necessary to show that it is the creosote and not the manner of injecting it or the particular timber tested, which is responsible for his results. Such tests are in process and in contemplation, and I will be much surprised and disappointed if the same timber treated when air seasoned and with moderate temperatures, does not give better results. It is very unfortunate that more tests to prove the theories and methods in timber treatment have not been made; and disappointing as Mr. Hood's results are, the facts are needed and his work may result in showing a decided difference in the value of the various ways of applying the preservative.

The greatest demand, of course, of the railroads on our forests is for ties. A perfect preservative must be a germicide, which is insoluble in water, non volatile under usual temperatures, preferably an excluder of air and water—and cheap. In the dead oil of coal tar, we have the first three elements and the fourth to a considerable degree. By the usual methods of injection, it cannot be called cheap, except in consideration of its ultimate economy through long life. Creosote in America is worth about one cent. per lb., delivered at the works. The cost of the ties treated depends upon the amount injected. In Great Britain they use from 8 to 10 lbs. of oil per cu. ft. of timber for Baltic red-wood; in France and Germany for beech and pine, from 10 to 20 lbs.

The life secured from the ties varies pretty closely according to the amount of preservative used.

On the basis of 10 lbs. per cu. ft., a tie containing 3 cu. ft. would cost here for oil alone, 30 cents.

The usual charge made by treating works for labor, fuel, profit, etc., is from $5 to $7 per 1,000 ft. B M. This adds to the cost of oil 20 to 25 cents. The cost of a 12-lb. treatment would be about 15 cents per cu. ft.

The cost of Burnettizing is about.3¾ cts. per cu. ft.
of Zinc tannin is about....5 cts. per cu. ft.
of Zinc creosote .....7.5 cts. per cu. ft.

This high cost of creosote accounts for the many efforts to secure the same results with other materials, or with combinations with other materials which will reduce the amount of tar oil required.

One way of doing this is to put in less oil alone, but the trouble is that the injection is then superficial and any checking of the timber or wearing under the rail destroys the protection, permitting access of air to the unprotected center and early decay. The Southern Pacific made a test in 1895 in West Texas, where 1,694 sap pine ties were impregnated with 6 lbs. of tar oil per cu. ft., and laid in track with the same number of untreated ties of the same character. After 5⅓ years' service, not one of the creosoted ties had been removed, while 16 per cent. of the untreated ones had been taken out on account of decay. Unfortunately no later reports have been made on this experiment.

The principal objection to the processes using zinc chloride, sulphate of copper and other mineral salts is that such salts are all more or less soluble in water; some of them indeed hygroscopic. They are effective germicides, and as long as they remain in the wood in sufficient quantity, will prevent decay. It will probably be admitted that the injection of any antiseptic, which at the same time has no directly injurious effect on timber, is beneficial; and in proportion to its antiseptic power and its difficulty of removal. The solutions containing metallic salts are more readily injected than oils and it has consequently been attempted to use them in conjunction, and various methods have been patented for this purpose. Mr. J. B. Card, who introduced the Wellhouse treatment, proposed a method of first injecting a small amount of tar oil, then immediately thereafter, injecting a solution of zinc chloride. He stated by this means, he secured a much better distribution of the oil throughout the wood than was possible with the ordinary injection of the same amount of oil, and at the same time thoroughly protected the interior of the stick with the zinc chloride.

In Germany a method has been used for a number of years in which the solution of zinc chloride is mixed with tar oil and the two injected at one time into the timber. This method requires for its success a very light grade of oil difficult to obtain and of high cost, and there is some discrepancy in the reports of observers as to the uniformity of injection in ties occupying varying positions in the cylinder; the tendency being, of course, in any such mixture for the oil and water to separate on account of their varying specific gravities. This method however, has given satisfactory results in practice, and is undoubtedly an improvement over straight burnettizing.

In April, 1894, the Southern Pacific laid in western Texas, 1,824 sap pine ties, which were given an injection of 12 lbs. of 2 per cent. solution of zinc chloride. The ties were then removed, allowed to dry in the air for ten days, replaced in the cylinder and given a second injection of 3 lbs. of creosote, both quantities being in lbs. per cu. ft.

At the same time 1,694 untreated heart pine ties were placed in the same piece of track. In December, 1900, after nine years and eight months of service, 8 per cent. of the treated ties had been removed, and 94 per cent. of the untreated heart pine ties had been removed.

Another method of doing the same thing has been that of injecting the solution of zinc chloride and immediately following this with a second injection of tar oil, the first injection being stopped at the proper point to permit the injection of about 3 lbs. of tar oil per cu. ft. A number of these ties have been in service for six or eight years with very satisfactory results.

I have given above a statement of the comparative costs of the zinc creosote treatments as compared with others.

There is one other treatment which has been before the public for some years, and which has some very desirable theoretical features about it; namely, the Hasselmann process. This consists in boiling the timber in a solution of several substances, the principal one being sulphate of iron. There have been a number of treatments proposed whose value was based upon the securing of a chemical reaction in the wood itself, but there has been a good deal of scepticism about the securing of such reactions and the Hasselmann process seems to be the only one in which clear evidence has been given of success in that regard. This process is very cheap, the penetration of the wood thorough, and it is to be hoped that the claims of the promoters thereof may be justified by the test of time. The actual value of this process, however, for ties is still to be demonstrated, as compared with other treatments.

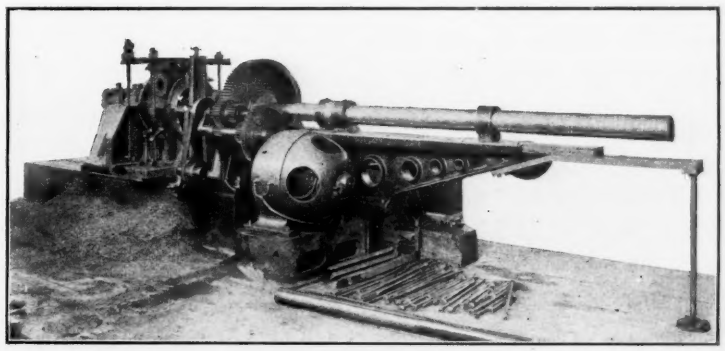
I have so far failed to mention a modification of the zinc chloride process known as the Wellhouse treatment. This consists of the injection of zinc chloride, followed by injections of solutions of glue and of tannin, the object of the two latter being to plug up the ducts of the timber by the artificial leather formed by the glue and tannin. This treatment has been in use in this country for a number of years with very satisfactory results, although it is now disputed as to the increased cost over the ordinary burnettizing being justified by the increased life secured.

I do not propose to cumber your records with long statements as to the detailed results of treatment in this country, and I will only say that the Atchison, with an experience extending over 17 years, shows an average life for inferior pines and spruces treated with zinc chloride, of 11 years. The Atlantic system of the Southern Pacific, with the same number of years' experience, shows a life of sap pine ties treated with the same material of nine and one-half years, while the Pacific system of the same road where treated ties have been used for 10 years report 57 per cent. of the ties laid in track in 1895 as being in service after eight years. The Pennsylvania Railroad in a test instituted in Indiana in 1892, where burnettized hemlock, and untreated white oak laid in rock ballast, show an average life to date of 10.58 years for the first and 10.17 years for the second, with 41½ per cent. of the hemlock and 33 per cent. of the oak still in service. With burnettized tamarack, an average life of 8.84 years and of untreated white oak 9.47 years, both laid in gravel ballast and with now all of the ties removed, has been secured.

In a paper read last year before one of our societies, I summarized the situation as follows: "It is safe to say that whenever an inferior tie can be purchased and treated by burnettizing, and then cost no more than a white oak or other first-class tie, the adoption of treatment by that or a better process is justified. It may not be possible to determine which particular treatment is the most profitable, but this should not be considered as justifying the failure to begin treatment. A plant should be designed to treat by either, and if the future necessitates a change, this can be readily made; and in the meanwhile, which ever has been adopted, it is reasonably certain results will be worth the cost."

Motor-Driven Cylinder-Boring Machine.

The accompanying illustration shows the application of a motor drive to a No. 2 locomotive cylinder-boring machine, made by the Newton Machine Tool Works, Philadelphia. The motor is a 15 h.p. Crocker-Wheeler standard type I, semi-enclosed. The C.-W. multiple voltage system of speed control is used. Two sets of sliding gears for speed reduction are also provided which double the speed range of the motor and controller. This machine will bore cylinders up to 30 in. in diameter, and will bore and face both ends of cylinders up to 42 in. in length. The machine was installed in the shops of the Jeanesville Iron Works, Hazleton, Pa., by Dodge & Day, Modernizing Engineers, Nicetown, Pa.



Motor-Driven Cylinder Boring Machine.

Foreign Railroad Notes.

The Russian railroads have long collected a tax of 2½ cents on each ticket sold for the benefit of the Red Cross Society. In consequence of the war this tax has been raised to 5 cents. Another result of the war is the reduction of the amount authorized for new railroad construction by $27,500,000, of $5,000,000 in other railroad appropriations, and of $2,150,000 for harbor works at Port Arthur and Vladivostok.

Russian railroad statistics for the first half of 1903 have already been published, showing the aggregate length in operation June 30 to have been 38,068 miles, including the lines in Finland and in Asia. Of these all but 11,978 miles were state railroads. Only 187 miles of new road were opened during the half year. The statistics of operation do not include the Finnish railroads (2,468 miles). The gross earnings for the half-year averaged $4,321 per mile—a very satisfactory amount. The Siberian Railroad meanwhile earned but $1,947 per mile, and the other Asiatic railroads still less. Statistics of traffic are given for every month, which ought to be very valuable for the domestic trade, but without comparisons with the previous year. Among the most significant shipments were 6,660,000 tons of coal, nearly three-fifths of which came from the Donez basin, and nearly all the rest of it from Poland; and 227,112 carloads—say 2,043,000 barrels—of petroleum and its products. The shipments of grain to border stations or to seaports, and so presumably nearly all for export, amounted to 3,828,640 tons, equivalent to 127,631,000 bushels of wheat. About one-fourth of it was wheat, 18 per cent. oats and one-eighth rye. The exports across the border by rail were not one-sixth of the whole. More than twice as much went to Black Sea ports as to Baltic ports. The grain shipments from points on the Siberian Railroad to the border were almost nil—only 95 carloads in all. The total number of passenger journeys on this railroad was 1,173,000 and the shipments of freight 1,102,932 tons.

RAILROAD GAZETTE

ESTABLISHED IN APRIL, 1856.
PUBLISHED EVERY FRIDAY
At 83 Fulton Street, New York.

EDITORIAL ANNOUNCEMENTS.

CONTRIBUTIONS.—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussions of subjects pertaining to ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

Owing to a printer's error in the article entitled "World's Fair Travel" in our issue of June 3, the wrong dates were placed over the figures of passenger earnings at the time of the Centennial Exposition. The first table printed last week (aggregate passenger earnings of all the railroads in the country, expressed in millions of dollars) should read as follows:

1873.	1874.	1875.	1876.	1877.
137.4	141.0	139.1	136.1	130.1

The Organization of the Lancashire & Yorkshire.

The diagram of the organization of this British railroad, in another column, shows in more minute detail than any heretofore published a strictly departmental assignment of duties. It is made for the control of about 36,000 employees, and for the operation of 571 miles of road, with 1,536 locomotives, 4,845 coaches and 30,956 freight cars owned by the company, and a large but unknown number of freight cars of private ownership. The train mileage for the last half year was: Passenger, 6,331,769; freight, 2,708,700. These figures give an idea of the density of the traffic (but not the amount of it, as the ton-mile accounts are not reported) on a complicated system reaching across England from Liverpool and Fleetwood on the west to Goole and Hull on the east coast.

The army of employees is large in comparison with a similarly situated American road, and this is due to several causes. The complete manual block system, and the interlocking of all points with signals, employs nearly 2,000 men. There are between 3,000 and 4,000 porters, but in comparing it should be borne in mind that these men perform services in handling freight and passengers' baggage, of a kind not commonly furnished by American roads. There are more that 500 horse drivers needed because the company does its own express freight business. In maintenance of way a much larger force is employed than on any American road. The hardwood wedges in the chairs need continual attention and the track is examined twice a day. The company makes all its locomotives and a large proportion of its materials and supplies, and 3,500 men are employed at the Horwich shops.

The number of men and the cost of working is heavily increased by the arbitrary requirements of the Board of Trade, with the object of serving the public demands and securing the greatest possible safety. They are not openly complained of, but the saving of life and the avoidance of wounds, considered unsentimentally as a commodity, are dearly paid for and are all the more high-priced because the methods are prescribed in minute detail by the Board, which does not consist of experienced railroad men, but of men who may fairly be called amateurs—honest and earnest ones.

Much can be learned from the systems of inspection. There are many inspectors, usually promoted from lower grades of employees, and they get near to the men whom they supervise, saving a world of trouble for the superintendents, saving life, preventing loss and costing not unduly. It is well worth study and imitation. An idea of their functions can be had from the following description of the duties of a few of them: Inspector Roberts, stationed at Victoria station, Manchester, has general supervision of the engines in the station; arranging movement of engines disorganized through fog, accident or failures. He is representative of the locomotive department on the Signal Sighting Committee, which visits all places where new signaling or alterations of the existing signaling are to be made. The representative on this committee, of each department, reports to his headquarters the recommendations arrived at. Roberts meets inspectors of other departments to inquire into delays or irregularities, when so ordered. He travels on locomotives to report their condition, etc. Inspector Young, stationed at Horwich, inquires into irregularities, delays and any other matters, as instructed. He travels on footplates of engines, reporting on their condition, as well as the working of the drivers. Inspector Horne, stationed at Horwich, is chiefly engaged in investigating and reporting on the running of goods trains; travels on the footplates, reporting on the condition of engines and the working of the drivers, and following up any other matters as ordered. Inspector Barnes follows up matters connected with the stores at the running sheds, checking books and demands, and following up any lost articles, etc. There are also usually two footplate inspectors attached to the head office who travel on the locomotives and record the running of the trains and workings of the drivers.

The departmental lines are sharply drawn, as may be seen. An instance of it is in the traffic (operating) department, where one officer has charge of the movement of passenger trains and another of the movement of freight trains. There would seem to be opportunities for friction in such a division, but the arrangement is said to work well. As is apt to be the case, the impress made on the organization is plainly affected by the previous training of the head of it. Mr. J. A. F. Aspinall, the general manager, was long the chief mechanical engineer. He designed most of the company's standard locomotives and the great shops at Horwich, which are in a way a model. As might be expected, his organizations of both of the engineering departments are elaborate and especially well done. For example, it may be said, generally, that every man entitled to be on the footplate is, in all his duties, in charge of the chief mechanical engineer's officers. Mr. Hughes, at the head of it, has a locomotive running department and his shed foremen employ, examine for promotion and discipline the men. They also handle wrecks. It is the performance of this function, together with the inspection system, which so greatly lightens the superintendent's work, or, rather, makes it possible for him to do his work.

One Way of Getting Discipline.

It may be well to study the methods of English railroads and find why it is that disobedience of orders by those who have to do with train movement is proportionately more frequent here than there. It is beyond question that our division superintendents are, at least, as vigilant, earnest and alert as theirs, but we have more accidents due to disobedience, and one road records two disobediences for each one hundred observations by "surprise inspection." With skilful officers who spare themselves not at all, and excellent material for employees, this is neither an excusable nor a tolerable condition. The way is wrong. The way out is first in choosing the right sort, and second in close watching.

In choosing: One English company refuses to employ, or rather does not employ, an engine driver who is a machinist—one who has served his time in the shops. They say that the locomotive is made and repaired by men trained for that purpose, and that any interest in or special knowledge of that part of the railroad's work by so much diverts the thoughts of the driver from his specific duty of watching track and signals and maintaining his engine's power. The drivers are recruited from the firemen class, who are in turn found among the ambitious and capable wipers and others employed around the stalls. They tell us that it is quite unnecessary for a driver to be a machinist; that repairs are not made on the road; that in case of breakdowns but little is needed beyond a skilful use of the wrench and hammer; that, for example, only ordinary gumption is wanted for uncoupling one side and running in with one cylinder. This is in sharp contrast to the practice on some American roads, and, if it is true, that the English system of recruiting gets safer drivers than we get, it does not prove that knowledge is dangerous, but rather that the capacity for repeating the same duty a million times without error is so considerable an accomplishment that it can only be got by a training which shuts out time for other thoughts while on duty. Mr. M. N. Forney long ago found that he could not safely run a locomotive, even of his own design, from station to station.

It is commonly said that, by reason of the somewhat more clearly defined class distinctions in English life there exists there a great body of men of moderate ambition, better fitted than those we have for comparatively humble duties. This is believed to be only partially, if at all, true. The peoples of the English-speaking race are quite alike in capacity and accomplishment; the difference is rather that the class from which the splendid British "railway servant" is drafted is physically grouped and more easily accessible and identified, both by himself and by the officer who is looking for him, than it is in America, where the lines of distinction are less clear. We have an abundance of material for making a body of faithful, unerring, railroad employees sure of a comfortable living and a life service fully up to their capacity, but it seems to be the one bad result of the public school and the high school that too many are tempted to long for occupations for which they are not fitted. There are lots of professional men who would have done better on the footboard.

In watching men: The system of inspecting and reporting on strict observance, on English roads, is minute and inflexible. The passenger train crew consists of the driver, fireman and one or two guards. While waiting at a station platform the guard, at the request of a passenger, walked a few yards from his train to beckon a newsboy. The station master promptly reported this infraction to headquarters. Such reporting is invariable. Station masters, guards, signal men and drivers report every violation of rules and regulations whether or not it is a danger-causing one, without a thought of spying or unfriendliness. Small rewards of from ten to twenty shillings are on some roads paid to drivers and others who discover and report wrong conditions capable of causing an accident.

The vital element in British railroad organization for maintaining discipline in all departments is its staff of inspectors. Their number is appallingly large. More than a man to the mile of road are so classed by one company. Another reports about one-third, and still another about one-quarter as many inspectors as they have miles of road. But these inspectors do other work than that implied by the title, and they are of many grades. For purposes of present consideration we have to do only with those who relieve the superintendent of the impossible duty of watching and knowing his train and signal men. Such an inspector is paid from $30.00 to $80.00 a month. He has been promoted from among the guards, signal men or porters and known the mental and physical condition of all the men on his sub-division. Reports of station masters, and other employees, of observed violations of rules are referred to him. He is a king among his own kind; happy and content at this, the summit of his ambition; something of a martinet; apt to be as kindly as he dares to be, but with a sense of duty tuned higher than the military pitch. He is the soul of discipline and he fully relieves the superintendent from that harassing, nerve-destroying anxiety which comes from a sense of theoretical, but impossible duties undone. Nevertheless, the British engine driver occasionally runs blindly past a red signal, and the signal man occasionally gives a clear to a fast express when he has already accepted a light engine for a cross-over in his block; but this is the human fallibility which we are trying to eliminate by mechanical and electrical devices.

The lesson from the comparison, if there is a lesson, is that it may be better to omit from the requirements for enginemen everything which does not bear directly on competency for handling an engine in good order, on knowledge of the road, and on mental and moral capacity. That the American superintendent needs such help as the English superintendent gets from his inspectors is unquestionable.

Anti-Trust Remedies.

The *Yale Review* for May has an article of some length on "Anti-Trust Remedies, Under the Northern Securities Decision," from which we have quoted rather copiously in another column. The writer has not very clearly and satisfactorily pointed out what are the several anti-trust remedies he finds under the Northern Securities case, apart from such remedies under other cases in the same court, or apart from other remedies which have been more or less dis-

cussed in the public prints, without reference to any special decision. He is of opinion that this case "decides two constitutional questions of wide bearing: first, that the constitutional right of any person to buy and hold any piece of property . . . does not enable one corporation to purchase a controlling interest in the stock of another against the will of the sovereignty by whose permission the latter conducts its operation; and, second, that the jurisdiction of the nation over interstate and foreign commerce is so broad that the ownership of the stock of corporations, engaging in that commerce, is subject to Federal regulation to some extent at least."

That these propositions may remotely, in effect, follow from what the court did decide is perhaps in a certain sense true. But the author is quite misled, we think, in concluding that the court decided that it had jurisdiction to determine whether a corporation of one State has a right to purchase a controlling interest in the stock of another corporation of a different State, or that the court decided any such question. The real question before the court, stripped of all technical covering, was whether the Northern Securities Company was a combination or conspiracy to restrain interstate commerce, and whether its acquisition of the stock of the Great Northern and of the Northern Pacific was in restraint of such commerce. What puzzled lawyers before the actual decision was whether the court could possibly find that a lawful corporation was an unlawful conspiracy; whether a company legitimate in charter, regular in incorporation, innocent and commonplace in its nominal undertaking, could be adjudged by the court to be a mere cover for a combination in restraint of trade.

The court found, as a fact, that the company was incorporated to effect this unlawful purpose. It thereupon forbade the prosecution of the scheme. No one acquainted with the earlier decisions of the court and the facts of the case was surprised at the fact found by the court. What startled, or at least surprised, the country was the ease with which the court brushed aside the innocent, lawful, corporate shield to expose the guilty, unlawful combination beheath it. It was supposed that the form of the monopoly would be its safeguard, that the lawful panoply would forbid judicial penetration, that the law would not molest the law. The tremendous force of a legal presumption, in favor of a legal entity, supported the Northern Securities Company, but that was its only force. Once stripped of its corporate guise, it was as weak and commonplace in its formation and purposes as the Trans-Missouri Freight, or the Joint Traffic Association. When the court shattered this fair, but false fabric, necessarily the rights resting upon it fell with it. The stock of the company depended for its value upon accomplishing the purpose of the formation of the company and, when that purpose became impossible, dissolution was inevitable, as a practical result. In this remote and consequential sense the decision may be said to affect or even regulate the ownership of stock. But to say that the court undertook, in this case, to pass upon any question of the right of individual ownership of stock, or of the rights of stockholders among themselves in such a corporation, or to regulate such rights in any direct way, is quite unsupported by anything in the decision itself, or the opinions of the justices in support of it.

The case leaves all holding companies just where they were before it. It has made them neither better nor worse, neither stronger nor weaker, neither more lawful nor less lawful. He that is holy will be holy still, and he that is filthy will be filthy still. It is as if the court had said: "We have nothing to do with holding companies as such, but we shall enjoin combinations and conspiracies to restrain interstate commerce, wherever we find them, in whatever form, and with whatever consequences to those interested in them."

The writer of the article referred to thinks that there is a plain remedy to break up the Anthracite Coal Trust and similar combinations, and that is that the nation "provide that (after a reasonable time in which to unload present holdings) no company engaged in transportation shall engage in any agricultural, mining or manufacturing industry, or directly or indirectly hold any of the stock of any corporation engaged in such industry." But this remedy is not so plain to us as it is to the author. We are unable to see what authority Congress has to determine the objects for which a State corporation may be organized, or the kind or amount of property it may possess. The Supreme Court of the United States has expressly disclaimed, in this very Northern Securities case, any such power for itself or for Congress.

"It is now generally agreed," says the writer, "that publicity should be demanded from all of these large corporations. I do not mean a confidential disclosure of their transactions to Federal or State officials (a whisper that may sometimes prove more detrimental than helpful to the public interest), but a publicity which reaches to the stockholders." This, if it be possible, cannot be considered so much an anti-trust remedy as a nurturing trust regulation. It is not a trust preventive, but a trust preservative, having the purpose to convert all into "good trusts" by making them tell what they do. Though it is current with popular orators on political platforms to proclaim publicity as a panacea for corporate mismanagement, none of these gentlemen have undertaken to explain what they mean by publicity. A clear and practicable scheme does not seem to have been promulgated at all, or, if so, it improves little upon present legal requirements in many States. Ordinarily there are three classes interested in the large corporation, or so-called trust—first, the managers; second, the stockholders, and, third, the general public. As long as the managers work faithfully and successfully with the stockholders to fleece the general public, publicity is not demanded—except by the party fleeced. But, as a capacity of this sort grows by exercise, it soon becomes profitable to take advantage of every opportunity presented, and in time the stockholder himself becomes a victim also of the manager. This secondary victim has no right to complain of the very processes he has inflicted upon others. When robbers fall out they have no redress, in our law, for an unequal and unjust division of the spoils. If one deliberately joins a trust, we may with equanimity leave him to the consequences of his choice. Why should the rest of mankind suspend its labors, to devise some scheme, publicity or what not, to help the plunderer get more plunder, or preserve what he has already acquired? What the law perhaps owes to such unfortunates, besides the remedies open to all, is to require that all trusts should be branded as such, just as oleomargarine is required to be marked, or a vicious dog to be muzzled. This sort of publicity is doubtless feasible, and, if not efficacious in all cases, is at least harmless.

Let no one suppose that an innocent stockholder defrauded by the managers of his corporation has not his remedy. The law books are full of precedents for all kinds of relief. But the trouble is that the resources of his opponents are so ample as to lengthen out the contest in many cases beyond his endurance. And not only are numerous civil remedies supplied to a complaining stockholder in the several States, but they all abound with drastic criminal punishments against directors who are guilty of fraud or negligence in their office. But again, on this side of the law, the wealth of the accused commands such influence and means of defense that justice is more often chagrined than gratified. And back of all this, we regret to say, there exists a certain public opinion which does not require severe punishment to be inflicted upon unscrupulous manipulators in commercial transactions, a condition which may be natural, in a country developing more rapidly perhaps than safely.

But the question we are all interested in is what can be done, and what ought to be done, to protect the general public from the evils of vast aggregations, whether of capital or labor, which respect not the laws of man or nature. If the remedy be found in "publicity," what sort of publicity? What is to be published—the minutes of the directors, the issue of stock and the summaries from the treasurer's books? All these are usually published, either under the law, or by the newspapers, but, like dead men, they tell no tales. Statements of general condition, annual reports and prospectuses are so phrased as to be reassuring to the inveigled, and alluring to the outsider, generally true in a sense, but substantially false and misleading. They may comply with the law, and yet convey no information worth the having. A few bold, unwary men may be caught and mulcted, but an indictment upon these formal reports—"publicity"—is rarely followed by a verdict of guilty, and still more rarely by incarceration. What else does this "publicity" mean? It may include a large number of meaningless or unimportant details. It may include also the short, simple and innocent annals of debits and credits, assets and liabilities, with their tedious balancing to a cent. But all these together do not furnish the clue to what has gone on, under the rose, during the period covered, which one may imagine though he does not know, or which he cannot imagine and will never know. What we all want "publicity" to tell us is how the managers made $40,000,000 in forty weeks, how much they must pay back, and what they did that was unlawful, and when and how. Can we expect "publicity" to persuade these gentlemen to do these things? Indeed, the fundamental defect in "publicity" is that it does not tell us what we want to know, and does tell us what we do not want to know.

The fact is, there are, in our judgment, no legal anti-trust remedies worthy of the name, and, furthermore, there can be none, and ought to be none. The trust is as much a natural development in the commercial world as vegetation in the natural world. It sometimes takes on an exaggerated, abnormal and injurious growth, like that found occasionally in plant and animal life. It is the tendency of the time, watered and fertilized, in a congenial soil. In this process not a few ogres and blood-drinking giants, enemies of the human race, merely, are engaged, but many respectable law-abiding citizens of moderate means, seeking a reasonable opportunity for the exercise of their abilities, or the investment of their capital. We are going to hope that these large combinations will some day be all quite free from the shams and frauds and tyrannies that have disgraced so many of them—a consummation to be effected not so much from high spirituality as from the stern, inevitable requirements of commercial success, and the law of the survival of the fittest.

The Texas Railroad Commission as a Law Maker.

The Texas Railroad Commission, with its positive ideas and its exceedingly direct way of doing things, generally manages to keep itself in print most of the time. It now appears that Commissioner Colquitt has discovered that he is a first class law maker and feels somewhat galled that the State Attorney General should entertain doubts as to his authority. The Commissioner introduced a resolution before the Railroad Commission last month to the effect that the giving of free passes by railroads in the State was discrimination in favor of the recipients and was at variance with and denounced by the State Constitution and statutes. The resolution further ordered that after Dec. 31, 1904, the Texas railroad companies should be prohibited under penalty of the law for discrimination, from issuing free transportation to any one whomsoever, except their own officers and employees. The resolution was referred to the Attorney General of the State for his opinion as to the authority of the Commission to make such an order, and the Attorney General replied definitely and concisely that the Commission had no such power. He added that the Legislature was clothed by the Constitution with authority to pass laws, and among other things to prevent unjust discrimination and extortion in rates, and said that the Legislature presumably could have created a commission with such powers had it desired to do so, but it had not seen fit to confer this authority.

Commissioner Colquitt, however, in his capacity of law maker to the community was not to be deterred by any such minor hindrance as the opinion of the Attorney General, and in a long article published in the daily press immediately after the decision was given, adhered strongly to his own opinions and is quoted as saying: "For myself, I have no doubt of our authority to promulgate and enforce this order, and it should be done. If doubt exists, that doubt should be resolved in favor of the order." And again, "There is no trouble about a way if there is a will to do."

The Texas Producers' Review takes the foregoing incident as a text for a talk on the relation of the Texas Railroad Commission to the railroads of the State. It does not criticize the anti-pass order on the merits of the question, but simply from the way in which it has been brought before the public, and holds that Commissioner Colquitt is thereby creating political capital. In the words of the *Review*, "How long, O Lord, how long, before we can separate business and politics! . . . We folks at home understand these things. We know that the railroad corporations are fit, for lack of something else, to make capital out of, but it does us untold harm. The 30,000 and more people of other States who have their money invested in Texas railroads do not, neither can they, understand it. To them it appears as the doings of a whole people that are antagonistic to foreign money and railroads in this State. While our people in all sections of the State are calling for foreign money, more railroads, and immigration, and spending time and money to get them, their efforts are nullified by a few politicians standing high up in positions with which we honored them, and giving out opinions and expressions to attract attention wilfully which go all over the country as the opinions and expressions of our people at large."

This is merely another illustration of the fact which has been evident for some time that the railroad interests in Texas are sharply divided into three classes; consisting of the railroads, which provide transportation; the shippers, which provide traffic, and the Railroad Commission, which looks upon both classes with a marked suspicion that is cordially reciprocated. The population at large seems to desire the railroad facilities, and is apparently pleased with those it receives, whereas the Railroad Commission looks upon the railroads with ill disguised horror and disgust and places such restriction on them that a Texas railroad officer recently writes that he would not accept a certain proposed branch as a

gift free of all encumbrances, unless the Railroad Commission would agree to keep their hands off of it. Something seems to be wrong in Texas. Perhaps the State is getting an unusually severe example of the difficulties of separating business and politics.

"Politeness a Requisite" was the heading of one of the famous orders of General J. H. Devereaux when he was Receiver of the Atlantic & Great Western, years ago, when politeness was still more or less unnatural among trainmen. The wording of the circular is not remembered, but that is immaterial. The incident is recalled by a circular, recently issued by General Manager C. A. Goodnow, of the Chicago & Alton, which is one of those models of politeness that teach this virtue by example. As precept without example is in this matter quite worthless, this circular is worth quoting:

"TO EMPLOYES:

"In view of the very heavy passenger movement which is expected during the last half of the World's Fair period, we have, in common with the other St. Louis lines, requested our connections to limit their applications for transportation for their employes to the period prior to August 15, 1904, and it is desired that our own employes will arrange for their vacation and leave of absence so that the same limit can be placed on their transportation."

It is important to remember that lack of politeness is impoliteness. Railroad officers' circulars which lack the virtue that appears in the above are not usually to be criticised for marked bruskness, but rather for the lack of any quality, either good or bad. Likewise with trainmen, who should be constantly learning from their superiors; passengers do not have much complaint to make of decided incivility—of acts (or words) which can be defined and reported; but of silence, mental lethargy or inattention, where there ought to be alertness, intelligence and watchful care to help modest passengers and repress the boors. Now, as in General Devereaux's time, the impression made by a headline or by an example of any kind showing the mental attitude of the officer is likely to be worth whole pages of mere lecturing. Calling up the memories of the past brings to mind an utterance on this subject by a writer in the *Railroad Gazette* in 1883. Examining the rules of the principal roads, and finding few good examples on this subject, he advocated the summing up of the whole subject in a single line:

"PERFECT POLITENESS IS REQUIRED OF EVERY EMPLOYE."

And if we are right in laying the whole stress on example, this brevity of precept is just the thing.

In the early seventies the railroad man in the east who thought of going to the far west to grow up with the country was likely to be warned by his friendly and cautious fellow-workers to begin to cultivate his grit and his muscle at once; for, they would say, "hard characters are plenty out there; the conductor, in going through the train to collect fares, always has a brakeman follow behind carrying a link in his hand." Whether or not the civilization of Wyoming in 1870 has reappeared in the Metropolis in 1904 we cannot say; but the reporters of the New York papers soberly inform the world that the Brooklyn Rapid Transit Company, which carries the multitudes to Coney Island on Saturday and Sunday, has engaged a special force of a dozen "bouncers" to suppress rowdyism on its cars. The *New York Times* of Monday morning last says:

"The bouncers put in their first Sunday's work yesterday, and the 'rough-house' element came in for a series of unpleasant surprises. A party of three young toughs who were going to Coney Island early in the afternoon, picked a quarrel with an unoffending passenger. The three were starting in to do their victim up, when a broad-shouldered young man in a plaid suit and straw hat stepped in from the platform, grabbed one of the roughs by the scruff of the neck, and yanked him with no gentle hand out to the platform. Another 'bouncer' came in from the car behind, and dragged out another of the roughs. When the train reached the Park Place station the three young toughs were unceremoniously bounced from the cars, and there was no more trouble on that train. . . ."

Why should a railroad have to hire men to preserve order in a city with a well-organized police force?

NEW PUBLICATIONS.

The Manual of Statistics. 1904. 1,040 pages, 5½ x 8 in. Price $5. The Manual of Statistics Company, 25 Broadway, New York.

This useful stock exchange hand-book again makes its appearance, entering with the present edition upon the twenty-sixth year of its existence. The size and general appearance is the same as in recent years and the compact arrangement of the information contained provides a work which is comprehensive without being unwieldy. As previously, a large part of the book is devoted to the statistics of railroad and industrial corporations, these two groups showing 800 pages, of which 331 are occupied by the railroads and 469 by industrials. As an example of the special features which the book contains, apart from the condensed statements of physical characteristics, stock and bond issues and earnings and expenses, may be mentioned the table showing comparative freight traffic and rates of the principal railroad systems of the United States. Some sixty roads are included and the comparison covers the current year and the year previous, and deals with average mileage, total tonnage, ton mileage, freight density, ton mile rate, train mile earnings, and train load. This table alone is of the greatest value for statistical purposes and as a handy means of securing the most vital traffic statistics of the larger roads. There are also tables of new railroad construction built for a series of years, and lists of foreclosure sales, roads for which receivers were appointed for the current year and a summary of railroad receiverships for 28 years. Industrial corporations are also fully described in the portion of the book which deals with them, and a three-year stock market record is given of securities dealt with in Chicago, Cleveland, New York, Pittsburg, etc. The production and prices of a number of commodities are also presented in tabular form. The book as a whole contains an astonishing amount of useful information concisely expressed.

British Railways. Their Organization and Management. By Hugh Munro Ross. Edward Arnold, Publisher. London. 1904. 5 x 7. Price 5s.

Several books have been written recently on the general organization scheme of the railroads in Great Britain. Mr. Ross does not attempt to make the comparison with other countries which some of these books have contained, but devotes 236 pages to a careful and thorough account of the British roads. He deals first with the growth of the systems, their building, promotion in Parliament, etc., and follows this general preliminary statement with chapters on competition and combination, the management of the traffic and other departments, sources of revenue, and discussion of the imperfections of different kinds of statistics, etc. The high capitalization of the railroads, which has occasioned so much adverse comment from foreign critics, is discussed in the last chapter of the book. Mr. Ross, after calling attention to the obvious necessity of higher cost for railroads in a country where the prevailing mileage is double track as compared with that of a country where it is single track, comments also on the fundamental difference that in America the railroads have been required to build up the communities and have been aided in every way and allowed to put very cheaply built lines in operation, whereas in England he says that the roads might almost be said to have been looked upon as a kind of public nuisance which ought to be obliged to pay heavily for the mere privilege of existing, so that their promoters have, as a rule, had to work in the face of obstruction from all sorts of quarters, especially from the landed interests. Mr. Ross's book gives a very good idea in comparatively short space of the British roads, their growth and development, and their general characteristics and position.

Twentieth Century Locomotives. By Angus Sinclair Company, New York. Railway & Locomotive Engineering. 1904. Illustrated. Cloth, 670 pages. 6 in. x 9 in. Price $3.

The arrangement and construction of the book is good, the printing is in large clear type, and the engravings are clear and well executed. The aim of the volume is to give those in charge of the maintenance and repair of railroad machinery descriptions and illustrations of modern practice. The greater part of the work is taken from the pages of *Railway and Locomotive Engineering.* The title of the volume is rather misleading, inasmuch as the first 488 pages are devoted to shop work, including repairing locomotives and boilers, descriptions of machine tools and shop appliances, a list of formulas, and a few definitions of engineering expressions. The remaining pages give illustrations and general dimensions of modern locomotives.

Confessions of a Railroad Man. 5 x 7½. Cloth, 159 pages. Published by The S. R. I. Community. New York. 1904. Anonymous.

The author of this entertaining little book might be said to talk rather than write of his interesting and varied experiences from the time when he ran away from home at the age of nine to enter a Chicago dry-goods store up to his present position of responsibility, which is only hinted at, however, in the stories he tells. There are 20 of these narratives, dealing with life in a good many parts of the country, but particularly in the newly settled West some 25 or 30 years ago. There are many examples of the writer's cheery disposition and ready wit.

TRADE CATALOGUES.

The National Car Coupler Company, Chicago, has issued a new catalogue of its devices. The opening pages show the National passenger equalizing yoke and the Hinson emergency knuckle. The National freight, National passenger and National passenger No. 5 P follow. The National "Midget" is a design for mine and other industrial cars of from two to seven tons capacity, and weighs 33 lbs., and the "Samson" is a heavier, stronger construction for cars of eight to 12 tons capacity, weighing 52 lbs. The National steel platform and buffer, and various forms of Hinson draft gears, are also shown. The last page is an order sheet with detail parts of the different devices.

Northern Electrical Manufacturing Co., Madison, Wis., sends out a folder replete with philosophy suggestive to the users of machine tools of the advantages to be derived from motor driving. This company makes a specialty of designing and building electric motors for the application of electric driving in industrial plants.

Falkenau-Sinclair Machine Co., Philadelphia, Pa., publishes a four-page folder, illustrating and describing a new form of cement testing machine with a capacity of 1,000 lbs. It is designed to automaticallly record the breaking load of the briquette.

The Chicago Tool & Supply Company, Chicago, issues a little folder descriptive of the Hayes electric drill and the Green pneumatic hammer. This company is also western agent for the Blaisdell air compressor, and handles air hose.

The Bangor & Aroostook has issued a circular announcing the opening of Mt. Kineo House on Moosehead Lake, Maine, on June 15th, in consequence of the large demand for the accommodation of summer pleasure seekers.

Applications of Steam Turbines.*

The development of the steam turbine is the result of efforts to increase the efficiency of turbines so that they may compete commercially with reciprocating engines. In common with all other steam-engines, turbines transform into mechanical work the energy given out by steam during its expansion from the initial pressure of admission to the pressure at the exhaust. But while reciprocating engines effect this transformation of energy by means of variation in pressure of the steam, turbines can effect this transformation both by means of the pressure and by means of the velocity of the steam while expanding. The use of the velocity only in each moving wheel characterizes the impulse turbines, among which are the de Laval and the Curtis types as well as the design of the author. The use of velocity and the partial use of the pressure characterize the reaction turbine, of which the best-known type is the Parsons. Whatever may be the method in which the steam acts in the turbine the chief problem consists in the efficient use of the great velocities attained by the steam in expanding. When the expansion takes place in one stage, as in turbines with a single wheel, then the velocity of flow reaches in a condensing engine, a value which is usually above 3,600 ft. per sec. But in order to obtain the maximum efficiency, the moving part of the machine should have a relative velocity which is approximately one-half of that of the steam. As it is practically impossible to construct turbine wheels suitable for running with a peripheral velocity above 1,200 ft. per second, the efficiency of turbines with a single wheel is necessarily low, this being due chiefly to the necessity for the employment of diverging inlet nozzles, which give rise to great losses of energy by friction and eddying. On the other hand, angular velocities which correspond to these peripheral speeds prevent the direct driving of dynamos, and render necessary reduction gears of special and costly construction, which, however, cannot be protected from excessive wear, and are exposed to accidental breakage.

A consideration of these circumstances has induced inventors to divide the expansion of the steam into successive stages, and thus to produce turbines with multiple wheels, which are nothing but a series of simple turbines mounted upon the same shaft and driven successively by the same current of steam. This design of multiple turbine is by no means novel. It will suffice to mention the name of Tournaire, a French mining engineer, whose theoretical description to the Academy of Science in 1853 of a re-action turbine with multiple wheels is surprising when the description is compared with the Parsons turbine brought into use 30 years later. Every simple turbine may be designed either as an impulse turbine or as a reaction turbine. In the former the fall of pressure under which the simple turbine works takes place solely in the distributor, while in the latter type the fall of pressure takes place, not only in the distributor, but also in the moving wheel, so that in the latter type there is a higher pressure in the guide-vanes than at the exit. Fig. 1 represents the guide-vanes and the moving vanes of an impulse turbine, in which the fall of pressure is small enough at the vanes to render unnecessary the use of diverging nozzles as in the de Laval turbine. In the illustration the triangles of velocities are given at the entrance OAB, and at the exit OBC of the moving wheel. Similarly in Fig. 2 are shown the guide-vanes and the moving vanes of a reaction turbine, and the triangles of velocities at the entrance OAB and at the exit OBC of the moving wheel are also shown. By the mere inspection of the moving vanes, it is possible to distinguish between an impulse and a reaction turbine. In the impulse type the vanes appear in section in the form of an arc of a circle with entrance and outlet angles practically the same, while in the reaction turbine the cross section of the vanes is in the form of a parabolic arc, the entrance angle being more or less approximately 90 deg. while the outlet angle is generally between 20 deg. and 30 deg. Generally the vanes are increased in thickness in the middle, so that the steam spaces between them have approximately a constant section for impulse turbines or a decreasing section for reaction turbines. If, however, they are made of plate they may have a constant thickness as in 2, Fig. 1. In reaction turbines it is important that the increase in thickness should be suitably calculated, otherwise there will be an important loss of efficiency. It is otherwise with the impulse turbine in

*Abstract of a paper by Prof. A. Rateau, of Paris, read before the joint meeting at Chicago, of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers.

which the efficiency is very little affected whether the vanes have a constant or variable thickness. In a given turbine with multiple wheels the different simple turbines may be all designed in the same way or some may be designed in one way and some in another way to produce a hybrid system.

Fig. 3 is a diagram of a drum turbine, and Fig. 4 a diagram of a multicellular turbine. These two types have different properties, so far as losses of steam are concerned. In the multicellular impulse turbine leakage of steam can only take place through the play c, Fig. 4, which exists between the shaft and the ring of the fixed diaphragm which surrounds this shaft. In the reaction drum turbine, on the contrary, leakage may take place: 1st, around the moving wheels in a, Fig. 3 (by reason of the reaction); and 2d, in b through the play between the guide-vanes and the moving drum. The first leakage can be suppressed, if desired, by making the wheels work by impulsion instead of by reaction, but then the second leakage between the fixed vanes and the moving wheels attains its maximum. It is because of this leakage at the pheriphery of the drum that turbines of the Parsons type require the most accurate workmanship. It is easy to understand that a play of some tenths of a millimetre is sufficient, at least upon the high pressure side, to produce a cross-sectional area of the leakage passages equal to that of the admission passages between the distributing vanes. In multicellular turbines the leakage, being confined to the periphery of the shaft, is reduced in proportion to the radii of the shaft and the drum; and moreover, friction being less to be feared at a place where the relative velocities are smaller, the play may be reduced to the absolute minimum. In practice we do not trouble about giving this play any precise value. We build the machine with practically no play round the shaft, and when started the machine itself makes play sufficient to turn without touching the internal rings of the diaphragms. We have found that frictional losses represent only from 2 to 4 per cent. of the normal power developed by the machine. These figures apply to turbines with an output exceeding 500 horse-power. These figures are comparable with those obtained in drum turbines in which the friction of the moving vanes themselves must be added to that of the cylindrical surface of the drum.

Another type of turbine which really belongs to the impulse class is the Curtis. Instead of using upon a single moving wheel the velocity of discharge of the steam leaving the distributor, it is used upon several wheels arranged in series in order to gradually diminish the velocity.

The type which has a group of wheels possesses the advantage of allowing a great reduction in the speed of rotation for wheels of the same diameter and of the same number. It would therefore be preferred to all others if it had not the grave defect of preventing a sufficiently high efficiency. Owing to the great velocity of flow of the steam in the first wheels, the losses of energy by friction and eddying are very great, reaching such a value that the second wheel develops less power than the first, and the third wheel less power than the fourth, when more than two are used, and they act more like brakes than prime movers. The Curtis turbine, as originally constructed, had groups of four wheels, then groups of three and then to groups of two wheels. Even with such a reduction in the number of wheels in a group the efficiency, according to our calculation, is still at least 20 per cent. lower than that obtainable with the multicellular turbine which has only one wheel per cell.

An interesting characteristic of the Rateau turbine is that it allows considerable play between the fixed and moving parts, which greatly facilitates construction and obviates dangerous friction if the bearings become worn or the shaft bent. The wheels also revolve in a chamber where the pressure is uniform. There is an absence of longitudinal thrust upon the moving parts and no necessity for the use of dash-pots for the purpose of overcoming the effect of this thrust, although such dash-pots are necessary in reaction or drum turbines. In the impulse type partial injection of steam is possible, that is to say, the steam may be directed upon a limited portion of the circumference. The moving wheels are formed of discs of sheet steel and upon the periphery of these discs are riveted cylindrical vanes. A steel band riveted to the periphery maintains the correct spacing of these vanes and gives rigidity. These wheels turn between circular diaphragms fitted with distributing vanes which enter circumferentially into grooves formed in the interior of the turbine case. Between two adjoining diaphragms is produced a cell or very flat chamber in which the moving wheel revolves. The shaft passes through the diaphragms in collars of anti-friction metal with very slight friction.

FIG. 1.

Guide-Vanes and Moving Vanes of an Impulse Turbine.

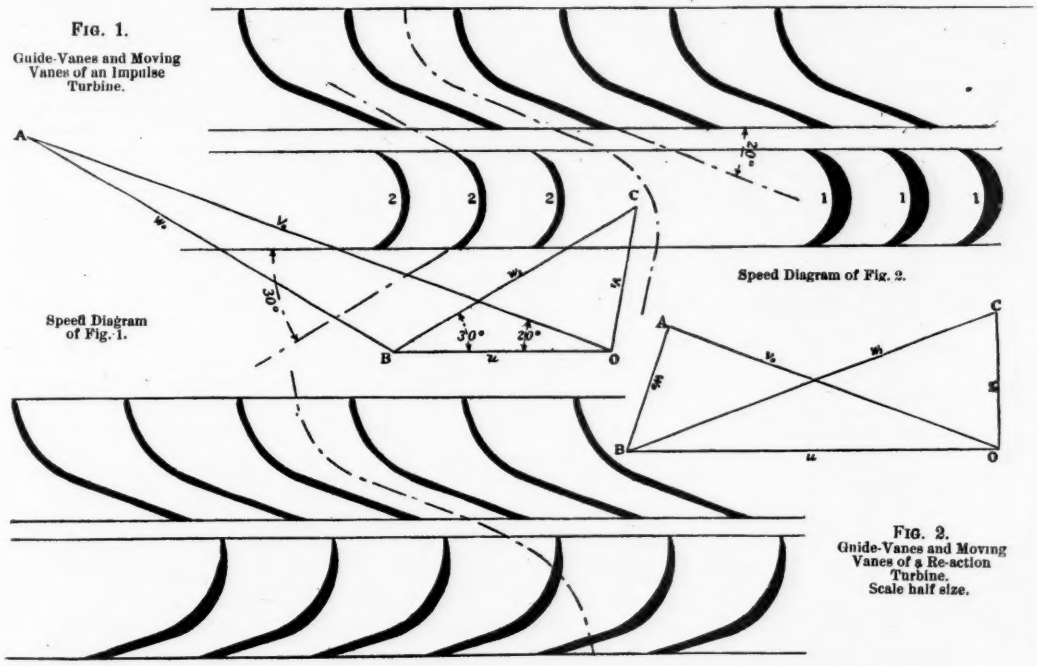


FIG. 2.

Guide-Vanes and Moving Vanes of a Re-action Turbine. Scale half size.

In the first diaphragm through which the steam passes, the distributing vanes are placed only upon a part of the circumference. Partial injection of the steam is therefore obtained, and thus the velocity of the steam is better utilized. Moreover, to produce the same effect the useful part of each distributor is set with an angular advance on the preceding section; this angle of advance is calculated according to the speed of rotation, so that the steam leaving one moving wheel enters into the following distributor and never encounters a solid wall which would produce a shock and therefore a loss of kinetic energy. For the last wheels it is necessary to employ total injection, that is to say, the distributing vanes must be set upon the whole circumference of the diaphragm, and moreover, owing to the expansion of the steam, the radius must be increased. The bearings of these turbines are external, and by means of a special system of spring packing they are kept perfectly tight. No oil is carried by the exhaust steam to the condenser, and this has an important advantage as the water of condensation can be used for feeding steam boilers direct without any necessity for the use of an oil-separator. The speed of rotation is controlled by a centrifugal governor with a Denis compensator, which acts upon an obturator which controls the pressure of steam entering the turbine.

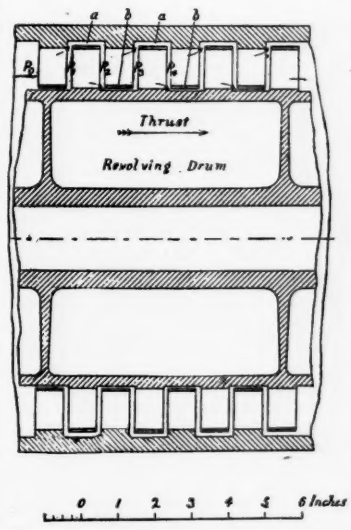


Fig. 3.—Reaction Drum Turbine (Parsons).

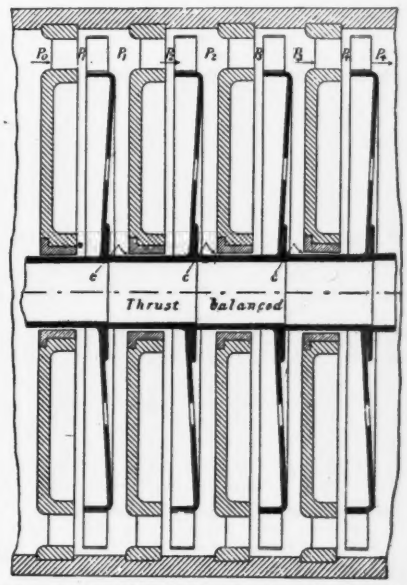


Fig. 4.—Multicellular Turbine (Rateau).

In the case of installations where exhaust steam must be used, it is often desirable to supply the turbines temporarily with steam at high pressure when the primary machine is stopped or is furnishing less steam, and the work done by the turbine must remain the same. In order to obtain economical working it is preferable not to expand this steam in order to lower it to the pressure for which the low-pressure turbine is built. Therefore, the author has designed a turbine which may be described as the "mixed type," and this can be supplied either simultaneously or separately by steam at high-pressure and by steam at low-pressure without any lowering of the efficiency of the mechanism. In order to attain this result the turbine is constructed in two parts, one designed for high-pressure steam and the other for low-pressure steam. The steam at high-pressure having done work in the first portion will pass to the second portion, which may be fed either by steam coming from the accumulator or by the exhaust from the first portion. The admission of high-pressure steam into the first portion is automatically obtained by means of a special regulator which allows steam from the boilers to pass to the first portion as soon as the pressure in the accumulator falls below a given value. This arrangement, which has been adopted in all the new applications of the system to the use of exhaust steam, works very economically, and is particularly suitable to cases in which the primary machine works irregularly, and where therefore the demand for live steam is frequent and somewhat prolonged. In the small machines the two portions are usually joined together.

It is essential that the word efficiency should be clearly defined in order to avoid any misconception as to the figures which are given below. The author uses the expression "Theoretical consumption of the perfect machine" to denote the maximum work which the steam is capable of supplying when starting from the saturated or superheated condition in which this steam is delivered to the engine and expanding adiabatically with no loss of admission pressure P to exhaust pressure p. By comparing the actual consumption of steam as measured during the tests of the machine with this theoretical consumption of the perfect machine for identical conditions of pressure and similar states of the steam the net efficiency of the machine is obtained. After special study the author has drawn a curve of theoretical consumption and derived from it the following empirical formula for use when the steam is saturated and dry at admission.

$$K = 2.13 + \frac{16.20 - 2.05 \log P}{\log P - \log p}.$$

in which K is in lbs. per horse-power hour and P and p in lbs. per sq. in. If the steam admitted to the turbines is superheated, then of course in estimating the theoretical consumption the extra calorific energy corresponding to the superheat must be taken into account.

The efficiency of a turbine may be calculated *a priori* when a preliminary study has been made of the practical coefficients which must be introduced into the theoretical formula. We calculate this efficiency with quite a remarkable degree of accuracy by dividing the losses of the machine under two headings: 1st, the internal losses which are produced by friction and eddying of the steam in the fixed and moving vanes; 2d, the external losses which correspond to the leakages of steam in the play between the fixed and moving parts, and to the friction of the wheels upon the steam and to the friction of the bearings. The first kind of losses gives rise to the *internal efficiency*. This internal efficiency depends upon the form of the vanes, and also on the relation between the peripheral speed of the moving vanes and the velocity of the steam. It is possible to draw a curve showing the efficiency as a function of the peripheral velocity, and therefore it is easy to at once assign the degree of efficiency which a given turbine will realize.

Once having fixed the internal efficiency, then, in order to obtain the net efficiency, we must deduct the losses by leakage as well as the losses by friction of the wheels upon the steam, and also those in the bearings. Let us take, for example, a multicellular turbine of 1,500 brake horse-power upon the shaft with a speed of 1,500 r.p.m. By means of practical coefficients found by experience we can calculate that the internal efficiency of such a machine may easily be 69 per cent.; on the other hand, the losses by leakage and by friction in the bearings absorb $^1/_5$ per cent. of the normal power, and the losses due to friction of the wheels upon the steam amount to 2.5 per cent., making a total for the external losses of 4 per cent. The net efficiency upon the shaft at the speed stated will then be 0.69 multiplied by 0.76 = 0.66. From this value of efficiency it is easy to calculate the consumption of steam per horse-power-hour which would be required by this turbine under conditions of pressure and of superheat of the steam already

determined. All calculations for designs of turbines that we have made by this means have always proved correct within 1 to 2 per cent. Such accurate calculations are not possible in the case of reciprocating engines owing to the action of the cylinder walls, whilst in the turbine the continuity of flow of the steam allows practical calculations of a high degree of accuracy to be based upon theory once having determined the fundamental coefficients which are employed in the formulæ.

The author began the construction of his first multicellular turbines in the year 1898 in collaboration with the firm of Messrs. Sautter-Harlé of Paris, and there are now already at work or being made turbines developing more than 25,000 horse-power in units varying from 10 to 2,000 horse-power. Some of these turbines are used for driving dynamos, others for pumps, for fans, and the the propulsion of vessels.

The company of the mines of Peñarroya in Spain installed in their central electric lighting station a little more than a year ago three groups of turbo-dynamos developing 500 electric horse-power with direct current at 240 volts. Each of these three generating sets comprises two turbines for high and low pressure, and two dynamos for direct current, the latter directly driven from the turbines upon the same shaft and upon the same bedplate, and the two dynamos supply a three-wire network with a potential of 480 volts between the outer wires. The speed of rotation is about 2,200 r.p.m., and the floor space occupied by the turbine with its two portions is only 12 ft. x 5 ft. 6 in., with a height of 5 ft. inclusive of a bedplate 1 ft. high. The condensation of the steam is carried out by means of ejector-condensers designed by the author. The turbine developing 644 electric horse-power and working without appreciable superheat between an admission-pressure of 156 lbs. absolute and an exhaust-pressure of 1.8 lbs. has given the reduced consumption of 14.9 lbs. per electrical horse-power at the terminals; the combined efficiency for the set being then 59 per cent. when compared with the energy contained in the steam for the same fall of pressure. With steam at 180 lbs. superheated 50 deg. and a vacuum of 29 in. of mercury, the consumption at 2,400 r.p.m. would decrease to 11.5 lbs. per electrical horse-power-hour.

These tests show the very low relative consumption of steam at small loads. In order to drive the machine at its normal speed with no load but with the dynamo excited, the total consumption of steam is only 10 per cent. of that at full load. With reciprocating engines the result would be very different. Under similar conditions the consumption of steam at no load with the dynamos excited usually reaches from 20 to 25 per cent. of the consumption of steam at full load. It therefore follows that turbine sets are more advantageous than reciprocating engine sets when running at light loads, even supposing it be admitted that there is equality at heavy loads. Another valuable property of steam turbines is that they may be considerably overloaded without difficulty. Thus, in the case of the machines at Peñarroya, which were designed for 500 horse-power, they have been able to develop 650 electrical horse-power, and the output could have been raised even still higher had it not been for the overheating of the commutators of the dynamos.

The construction of generators for two-phase and three-phase current for direct driving by turbines offers much less difficulty than the design of direct-current dynamos for the same purpose. The absence of the commutator renders possible higher angular velocities for alternators than for direct-current dynamos. Three types of alternators have been tried successively. The machine with the solid rotor, that with the rotating field magnet and that with the rotating armature. The first type would be, from a mechanical point of view, the ideal generator for coupling to a steam turbine. Unfortunately from its design it is impossible to use speeds higher than 1,500 r.p.m. for a frequency of 50 periods per second. On the other hand, this type of machine permits much greater magnetic leakage than the others, and this necessitates disproportionately large dimensions and a comparatively low efficiency. These circumstances are unfortunate, for the alternator with the solid rotor would permit of making the movable part of very solid construction which is easy to balance once for all and thus avoid any chance of mishap. A machine of 2,000 kilowatts at 1,500 r.p.m. would have a turbine efficiency of 68 per cent., which would enable the following guarantee to be given, assuming the use of superheated steam and the condenser giving a very good vacuum, which it is easy to obtain with steam turbines in which there is no entrance for the air:

Pressure of steam on admission to the turbine	200 pounds
Vacuum in the condenser	29 inches
Temperature of the steam	350 degs.
Consumption of steam per horse-power-hour upon the shaft of the turbine	8.5 pounds

This is a far better result than can be given by reciprocating engines, and this can be obtained with steam turbines under the conditions specified.

The author read a paper on the 25th of March last in London before the meeting of the Institution of Naval Architects upon the application of steam turbines to the propulsion of vessels. He then described the difficulties which occur in the application of turbines to the propulsion of vessels which are as follows:

(1) The difficulty of adapting screw propellers to the high speeds of rotation of the turbines.

(2) The poor efficiency of turbines at low velocity.

(3) The inconvenience of the combination in stopping and approaching quays. The best solution will be the use of a reciprocating engine of small power and of steam turbines coupled to independent shafts so that the reciprocating engine would always be working at any speed of the vessel. Then each type of machine would be perfectly adapted to the part which it has to play and excellent results in consumption of fuel would be obtained at all speeds.

The equipment of the French torpedo boat No. 243 with steam turbines was decided upon in 1898. In order to reduce the costs of this experiment as far as possible it was thought desirable to make use of the hull of an ordinary torpedo boat, but great difficulty was found in making room for the turbines, and moreover the propeller shafts were placed very high at the turbine end and were necessarily considerably inclined; in this case to 11 deg. from the horizontal. The back supports had to be considerably increased, and therefore the total resistance of the boat was much greater. All these conditions are extremely unfavorable and the screws fixed upon the inclined shafts gave a very bad efficiency. The two turbines, each of a nominal output of 900 horse-power, are completely independent of each other. They are provided on the exhaust side with a single moving wheel for movement in a reverse direction. As the experiment was solely made to see if the installation of turbines with propellers of small diameter was suitable for producing in a vessel a speed comparable to that given by a reciprocating engine, the backward movement of the turbine was willingly sacrificed. Very careful experiments have been made with this machinery, and a speed of 21 knots has been attained. It is quite certain that if the shafts had not been set at such a great inclination a speed of 24 knots would easily have been exceeded; for the turbines gave an output somewhat higher than was expected.

The application of steam turbines for the purpose of direct driving of centrifugal pumps enables remarkable results to be obtained and particularly renders possible height of lifts much greater than those which are at present obtained. It is well known that the pressure produced by the wheel of a centrifugal pump increases directly as the square of the peripheral speed, and therefore with the velocity produced by steam turbines it becomes possible with a single wheel to raise large volumes of water to heights of more than 900 ft. in a single lift. If it is desired to obtain either greater pressures or to obtain the same results with relatively lower speeds it is sufficient to couple steam turbines with pumps consisting of several similar wheels arranged in series so that each one increases by an equal quantity the pressure already given by the preceding wheels. The author has himself designed a particular type of multi-cellular centrifugal pumps. The first machine of this kind which was made was deilvered to the mines of Falkenau in Bohemia. This apparatus consisted of a single bedplate upon which were mounted a steam turbine with multiple wheels enclosed in the same casing, and a pump with four wheels also mounted in a single case. Tests showed that it is possible with such a turbine-driven pump to obtain combined efficiencies of 36.5 per cent., which corresponds to an efficiency for the pump of 67 per cent., and an efficiency for the turbine of 55 per cent. A more powerful turbo pump has been made and delivered recently to the Mining Company of Bruay, in the Pas-de-Calais. This set can raise 950 gal. a minute to a height of 1,200 ft. The total efficiency of this set is very high, attaining to 42.5 per cent. One of the chief advantages of turbo pumps, besides their excellent efficiency, is the extremely small floor space which they occupy when compared with piston pumps. Their dimensions are very small, and they require very little height, so that they can be placed in a room which has no greater dimensions than that of an ordinary working gallery in a pit. While ordinary reciprocating pumps for boiler feed purposes consume from 150 to 250 lbs. of steam per brake horse-power in water moved, the turbo pump for boiler-feed service will not usually require more than 40 to 60 lbs. per brake horse-power. Turbo pumps, both from the point of view of efficiency and also of ease in working, are particularly suitable for raising water into reservoirs for the service of towns.

The great angular velocity of steam turbines makes them particularly suitable for the direct driving of fans for high pressure used for blowing engines and even for air compressors. With a revolving wheel 10 in. in diameter and an angular velocity of 20,200 r.p.m., the turbo fan discharged 22.5 cu. ft. of air per second under a pressure of 19 ft. of water. The useful work contained in this compressed air was about 41 h.p., and the combined efficiency of the group was 30.7 per cent. The pressure of the steam at admission was 145 lbs. per sq. in. The application of steam turbines to air-compression has a great future, not only for work in mines, but also in metallurgy, where blowing engines of all kinds for blast furnaces and for the tuyeres of steel works may be replaced by the centrifugal machines much simpler and smaller and costing far less and requiring less repairs than the present piston engines.

One of the most interesting and promising applications of steam turbines is the employment of steam at low pressure, and particularly exhaust steam coming from engines working intermittently. The author has obtained satisfactory results by means of his regenerative accumulator of steam, combined with turbines at low pressure, which are coupled directly to dynamos, centrifugal pumps, or fans. The regenerative accumulator is intended to regulate the intermittent flow of steam before it passes to the turbine, and it consists essentially of a vessel containing solid and liquid materials which play the part of a fly-wheel for heat. The steam collects and is condensed as it arrives in large quantities in the apparatus, and is again vaporized during the time when the exhaust of the principal engine diminishes or ceases. The necessary variations for condensation and regeneration of the steam correspond to fluctuations in pressure in the accumulator, this pressure rising when the apparatus is being filled and descending when it is discharging into the turbine. Water (which has a very high calorific capacity) has been used as a heat fly-wheel, but in order to rapidly communicate to a liquid mass a considerable quantity of heat corresponding to the latent heat of steam to be condensed it becomes necessary, owing to the poor conductivity of water, either to arrange it in thin layers or to cause a rapid circulation in order to increase the surface of contact between the steam and the water itself. The first solution of the problem gave rise to the accumulator with flat cast-iron trays in which water is contained in shallow vessels arranged one above the other. The second solution of the problem gave rise to the accumulator with water only in which a rapid circulation was produced by the injection of steam into the body of the liquid. The low pressure turbine, fed by the regular flow which comes from the accumulator, and working, for example, between an admission pressure of 15 lbs. per sq. in. and a vacuum at the condenser of 27 in. of mercury (back pressure of 1.6 lbs.) can furnish an electric horse-power for about 31 lbs. of steam per hour. In a moderate sized plant, consuming 13,000 lbs. of steam per hour, it is, therefore, possible to economize under these conditions about 350 electric horse-power. In steel works, where reversible steam rolls are employed consuming about 45,000 lbs. of steam per hour, it will be easy to develop, by means of accumulators and turbines, an extra output of over 1,100 electric horse-power. The prime movers are in no way injuriously affected in their working by the presence of the accumulator and turbines. This method was applied for the first time at Bruay, and the installation has worked satisfactorily since August, 1902, when it was first put into use. The exhaust steam from a winding engine is first of all treated by an accumulator with cast-iron trays, and then passes to a low-pressure turbine of 300 horse-power, which itself drives two dynamos keyed upon the same shaft. A particular feature of this type of installation is the "automatic expander," which comes into use when the winding engine is not giving sufficient steam, and also when this engine is not working. This apparatus then permits the admission to the turbine of live steam which is passed from the boilers through reducing valves; this expander can be adjusted by means of a spring, and comes into use as soon as the pressure falls below a pre-determined point.

The enormous speed at which turbines must work in order to suit the velocity of flow of the steam is, in many cases, a serious inconvenience, particularly in the application of the turbine to the propulsion of vessels. It was a similar disadvantage for a considerable time in the driving of dynamos, but now it is possible to construct dynamos for very high speeds, and these can be coupled to steam turbines forming light and inexpensive sets which take up little room, although they are very powerful. Such sets are very simple and are very easily maintained. Besides the constant value of the turning effort, the chief advantages which can be claimed for steam turbines may be thus summarized: very low consumption of steam, particularly at small loads. From this point of view they are notably superior to piston engines of even the best-known types. Further advantages are the small floor space occupied and the absence of expensive foundation work; the cost of oil is very low, particularly for our turbines, which have oil reservoirs and ring lubrication to all the bearings. The oil in the reservoirs need be changed only once in two months, and it is not thrown out by the rotating parts, so that the machinery always remains clean. With steam turbines momentary or even permanent overloads are very easy to deal with. It is even quite possible to have overloads of more than 50 per cent. higher than the normal load. The regulation of speed in steam turbines is carried out in a more perfect manner than is possible for piston engines, and this is due, on the one hand, to the absolute constancy of the turning effort, and, on the other part, to the great kinetic energy accumulated in the revolving parts. This last characteristic makes the machines very insensible to variations in load. The full load may be taken off and put on again without causing a variation in speed of more than 2 to 3 per cent. When coupled to dynamos, fans or centrifugal pumps, steam turbines render it possible to obtain surprising results owing to their capability of giving great power at very high speeds. The author has constructed turbine-driven fans, giving a pressure of 7.5 lbs. per sq. in., and turbine-driven pumps raising water to several hundred meters. Such sets can now be built to develop several thousand horse-power, compressing air to more than 90 lbs. per sq. in., or raising water to more than 2,000 ft. Turbines are able to use to perfect advantage steam at low pressure, for they have an efficiency rising in value as the pressure of the steam becomes lower. In combination with steam accumulators of the type designed by the author of this paper, turbines permit of the employment of exhaust steam in large quantities produced by engines working intermittently, such as winding engines and engines used in metallurgical works.

The Bettendorf Truck.

Something over a year ago, Mr. W. P. Bettendorf, of Davenport, Iowa, perfected and placed in service a design of car truck, in which the primary object was to reduce as far as practicable the number of parts in the present M. C. B. standard arch-bar truck, and at the same time retain all its good features. This was accomplished by making the side frames, including the journal boxes, of one piece of metal, obtaining thereby a girder instead of a truss construction, and employing thoroughly annealed open-hearth cast steel. Fig. 1 shows the 41 parts composing one side frame of an arch-bar truck, for which a single piece is substituted in the Bettendorf design. Fig. 3 shows the parts of the Bettendorf truck except the wheels, axles and springs, which are common to both types. Fig. 4 shows the truck complete. It is erected without the use of a bolt or rivet. The two side frames are held in position by the column guides on the bolster and by the cross tie bar, corresponding to the spring plank, the latter having tranverse ribs which engage with recesses in the spring seats.

The smooth bottom of the cast-steel frame is expected to prove advantageous in case of derailments. The column and journal box bolts extending below the tie bars of the arch-bar frame are often the cause of much damage to truck frames, bolsters, and tracks in case of derailment, as they catch in the ties or against the rail, tearing up the track. The motion of the truck being arrested and the body of the car continuing to move forward, the trucks, bolsters and car framing are subjected to injurious stresses and distortion. The journal boxes are also likely to be broken by the bending of the journal-box bolts. The smoothness of the Bettendorf frame will permit it to slide along, offering little resistance, with consequent saving in damage to trucks, cars and track.

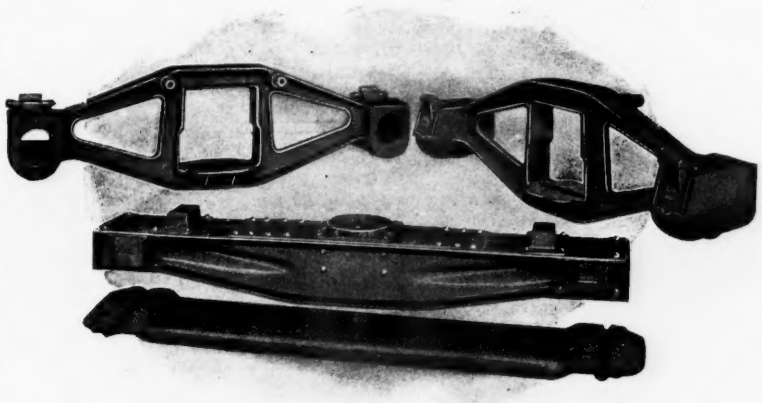


Fig. 3.—Parts of the Bettendorf Truck.

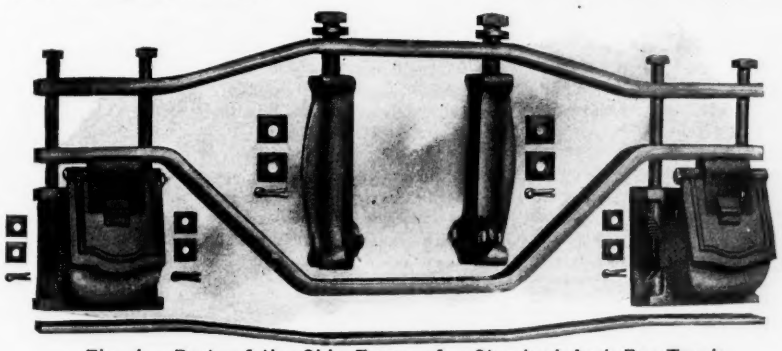


Fig. 1.—Parts of the Side Frame of a Standard Arch-Bar Truck.

Fig. 2.—Side Frame of Bettendorf Truck in One Piece.

In case of the breakage of a journal box on one of these frames, the whole frame is, of course, rendered useless. However, the makers meet any objection that might be urged against the design on this account by agreeing to replace the frame for the cost of an ordinary malleable iron journal box and its bolts. In case of failure of the frame through wrecks or any cause an ordinary arch-bar frame may be instituted, being interchangeable with the cast-steel frame.

To dismantle the truck for wheel removal, and reassemble it, not more than 30 minutes need be taken with the ordinary appliances of a car repair yard. This operation has been performed in 17 minutes by men not specially skilled in the work, therefore wheel renewals for this truck need cost no more than for the arch-bar design. The absence of all bolts greatly facilitates this operation. To dismantle the truck the bolster is first raised enough to remove the springs and spring plank, permitting the bolster to drop to the lower part of the frame where the distance between the columns has been increased, allowing the frame to slip over the column guides on the bolsters. If inside hung brakes are used the brake-beams are hung from bearings cast on the inner side of the frames.

Besides reducing the number of parts from 164 pieces per car in the arch-bar truck to only four in the Bettendorf truck the weight is reduced about 1,000 lbs. per car, while increased strength is claimed. The ideas embodied in this truck are applicable to both passenger and tender trucks. Designs of both types are now being built, and a number of the tender trucks are in service. Several hundred of the freight trucks have been in service over a year without a single failure. They are made by the Bettendorf Axle Company, Davenport, Iowa.

The Japanese are building a railroad 250 miles long on the island of Formosa, which was ceded to them by China after the war with that country, and which is best known to the rest of the world as the chief source of its supply of camphor. The cost is estimated at $15,000,000, the country being very difficult; but ten years is allowed for completing the work. In the summer of 1903 66 miles were already in operation at the south end, and some progress has been made at the other end. There has been great delay by landslides. There is a tremendous rainfall in the summer. Only $1,400,000 has been appropriated for the work this year, as money is now needed for other purposes in Japan.

Anti-Trust Remedies Under the Northern Securities Decision.*

The Northern Securities decision, if followed up by legislation, might prove to be a turning point in the history of that most effective form of the modern "trust" which is known as the holding corporation. The construction given by the court to the so-called Sherman Anti-Trust Law is not of very vital importance. If that construction had been different, the law could have been amended. It may be strengthened yet. What can be done under the present statute mainly interests lawyers. What can be done under the Constitution, whatever may be the present statute, mainly interests the public. The importance of the Northern Securities decision is in its constitutional aspect. It decides two constitutional questions of wide bearing: first, that the constitutional right of any person to buy and hold any piece of property, however much or little the right may be limitable by legislation, does not enable one corporation to purchase a controlling interest in the stock of another against the will of the sovereignty by whose permission the latter conducts its operations; and second, that the jurisdiction of the nation over interstate and foreign commerce is so broad that the ownership of the stock of corporations engaging in that commerce is subject to Federal regulation to some extent at least. The true analysis of the present decision seems to me to be that all State corporations engaging in interstate or foreign transportation do so by the implied permission of the nation; and that that implied permission can be subjected to a certain degree at least of restrictive regulation.

Few realize how very recent an affair the holding corporation is. I know of none earlier than the Pennsylvania Company, chartered in 1870. The Southern Pacific was chartered by Kentucky in 1884; and it was considered so dangerous a character that it was given no power to invade any of the corporations actually doing business in its own State. The development of the holding corporation upon a large scale is indeed so recent that it is actually contemporaneous with the popular anti-trust agitation. The genuine "trust" was killed by the Sugar Trust case in New York, which commenced in 1888 and ended in 1890, and the Standard Oil case in Ohio, which did not end until 1892. The Sherman law was passed by Congress in 1890. Yet, under cover of this anti-trust agitation and of the political excitements which were to culminate in the Presidential election of 1892, the astute financiers against whom the agitation was being directed were quietly obtaining legislation which would enable them to evade the decisions, and to a large extent the statutes, that had just been fulminated against them. The holding corporation idea in New Jersey did not germinate until 1888, and was not complete until 1893. On a large scale in New York it dates from 1892, under the governorship of the gentleman who afterwards led the famous "Flower boom." Up to that time the formation of the gigantic combinations with which we are now familiar would have been most difficult. This is why the old "trust" method had been attempted. It was only about that time that consolidation laws became liberal toward the promoters of modern combination; but even consolidation laws do not solve all of the promoter's problems. Often the personal factor prevents the formation of a monopoly upon this plan, and it can only be done effectively by stock purchase on an enormous scale—on a scale that is possible only when a corporation must be formed for the purpose of holding the purchases.

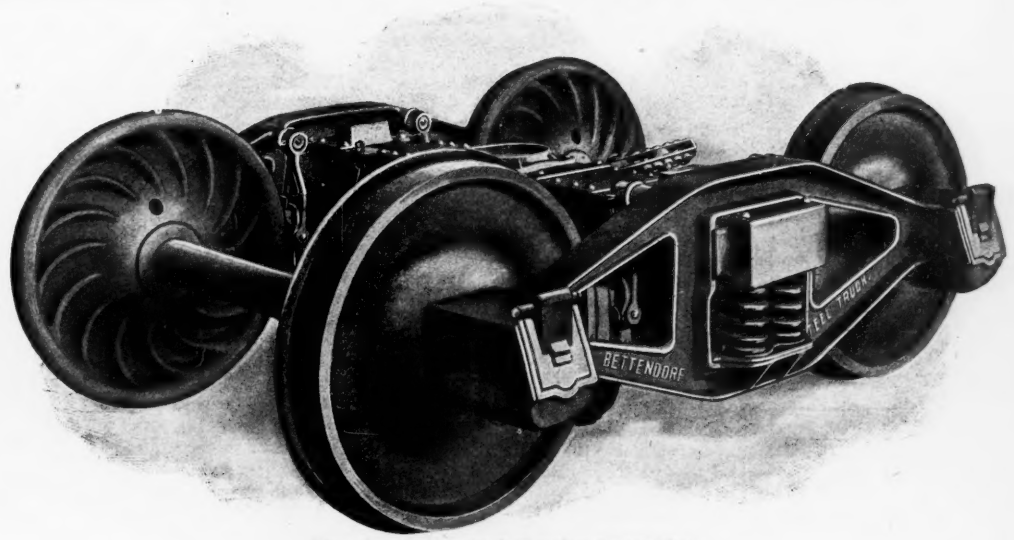


Fig. 4.—Bettendorf Truck—Assembled.

Since 1893 New Jersey has done a business very lucrative to her State treasury, in the exploitation of her new discovery. The process is simple. Three young men, with money which has been furnished them for that purpose, file a paper with the State authorities and pay a fee. They get a certificate in return which makes them into a corporation for whatsoever purposes they like, with whatsoever powers New Jersey is able to give them. Such rights as this piece of paper can give them they turn over to the gentlemen who had requested their services and furnished them with the necessary cash. All that the holding corporation does thereafter is to purchase stock in other companies, vote it in the stockholders' meetings of such companies, collect dividends therefrom, and divide the proceeds.

It is a necessary implication of the Northern Securities case, if there ever could have been any dispute about the point, that any other State may by appropriate legislation keep the New Jersey corporation out of its territory. By action of the several States the holding corporation may be extinguished as rapidly as it arose. For I think that those now existing are not protected by any constitutional provision. Any State may enact

*Extract from a paper by Edward B. Whitney, in the *Yale Review*.

that no corporation can hold in the future more than a given proportion of the stock of one of its own corporations. A reasonable time must be given those already existing to dispose of their stock and wind up. This is all the shrift that they can require. Whether the several States will—whether they dare—avail themselves of this power is more doubtful. Each legislature is subject to corporate influence; and each will be threatened with an emigration of capital to the territory of a rival. For reasons such as these, there has been a demand for an amendment to the United States Constitution, giving to the nation the control of the whole subject. The early adoption of this or any other constitutional amendment is improbable, and this one would be of doubtful wisdom. Congress has already so many subjects of legislation that it is on the point of breaking down, and would long since have broken down had it not parted with some of the characteristics of a deliberative body. It is questionable whether so complex an addition as this to its jurisdiction is possible without fundamental alterations in our system of government. If the Federal Constitution is not amended, and the States do not act, there is no power to stop the further growth by this effective means of the "industrial" trust pure and simple; for under the present Constitution Congress has no direct power to regulate an agricultural, mining or manufacturing industry. I shall therefore pass to the consideration of the corporations which Congress does have the power under the Northern Securities decision to control.

These may be divided into two classes: first, the transportation companies pure and simple, such as railroads and steamboat lines; and second, those aggregations which combine the work of production with that of transportation. Among holding companies of the first-class the latest development is the Rock Island; among those of the second class the most familiar is the United States Steel Corporation. To the second class also belongs (if it really is existent) the Anthracite Coal Trust, a supposed combination of transportation companies that by means of direct ownership, stock ownership, and bond ownership, control a large part of the coal mining business in certain important districts. If the nation desires to break up these combinations the remedy is plain, and has often lately been pointed out. It can provide that (after a reasonable time in which to unload present holdings) no company engaged in transportation shall engage in any agricultural, mining or manufacturing industry, or directly or indirectly hold any of the stock of any corporation engaged in such industry. It can enact that (after the lapse of a similar period) no corporation can hold directly or indirectly more than a given proportion of the stock of any corporation engaged in interstate or foreign transportation.

The holding corporation is not a natural outgrowth, but an artificial contrivance for the purpose of effecting combinations of capital to a degree and with a rapidity that human nature did not permit of under the laws amid which we grew up. While it has been a most effective instrument in building up monopoly, it has also been a most effective instrument of fraud upon stockholders and upon investors and upon the outside public. It has resulted in intricacy of organization so great that no public officer can be expected to understand it, and no ordinary stockholder can afford to get competent advice about it. When combinations are built up by simple processes of consolidation, or by the simpler form of lease, the predatory instincts of the promoters are somewhat restrained by inherent limitations. But when the United States Steel Corporation controls the stock of the Federal Steel Company, which in turn controls the stock of the Illinois Steel Company, which in turn controls the stock of the Elgin, Joliet and Eastern Railroad Company, and when these companies are commingled with a hundred others all bound together in an intricate system based upon a similar plan—when, as a result of a sudden turn on the Wall street market, giving a group of speculators momentary control of a railroad system chartered and operated under the laws of Illinois, these men are enabled to organize a holding corporation in Iowa for the purpose of owning that stock, and then to organize another holding corporation in New Jersey for the purpose of owning the stock of the Iowa corporation, and then to provide that a minority of the New Jersey stock (that, namely, which they think themselves financially strong enough to keep their grip on) shall control the New Jersey corporation—then it seems to me that public patience may be pardoned for breaking down, and demanding laws which shall prevent the manipulation in this manner of the great instrumentalities of industry and of commerce between the States. Nobody familiar with the financial history of to-day need be reminded of cases where profits have been left concealed in the treasuries of "sub-companies" (the humble name now given to the actual working corporations) until the ignorant stockholders, inferring from the published reports of the holding company that it is not earning even the moderate dividends which it is distributing, are ready to sell out; where when this time has arrived a sudden and mysterious "buying movement" appears upon the Stock Exchange, turning out to be a purchase by the insiders of nearly the entire stock of the holding company; where this movement is immediately followed by the organization of a new holding company which takes up the stock of the old one with bonds at double its par value, and an immense issue of its own stock on top of the bonds; where the stock of the new holding company, although subject to the bonds, turns out to be worth two or three times as much on the market as the stock of the old company had been; and where the concealed profits in the sub-companies' treasuries then come out and justify the new valuation. More common is the case of the holding corporation declaring dividends on apparently ample net earnings, until a sudden and mysterious "selling movement" eventuates in the discovery by the stockholders that the sub-companies had themselves been paying dividends out of capital, and were immersed in floating debt. Meanwhile the original insiders are out, and the other stockholders are permitted to become insiders themselves for the purpose of meeting the debt or going into insolvency.

It is now generally agreed that publicity should be demanded from all of these large corporations. I do not mean a confidential disclosure of their transactions to Federal or State officials (a whisper that may sometimes prove more detrimental than helpful to the public interest), but a publicity which reaches to the stockholders. This of course, in the case of the large aggregations whose stock is necessarily upon the market, is practically equivalent to complete publicity. It is singular how careful legislatures and even courts have been and still are to preserve a secrecy whose traditional importance comes down to us from the days when a trading corporation was little larger than a partnership; when the interests of the directors were usually identified with its prosperity; and when its stock was not usually the football of a stock market. There is no reason why the State should now guard from the real owners of a corporation the secrets of its managers. There is no reason why it should guard the secrets of the corporation from the public. If a corporation large enough in its capitalization to be a matter of interest to the whole public is not able to compete in the open, then there is no sufficient natural demand for its existence to justify its survival. It should be permitted to go to the wall. As a corporation increases in size, the evil possibilities of secrecy increase in geometrical proportion, even when the increase in size is by simple consolidation. If it is accompanied by the complexity involved in a series of super-imposed holding corporations, the evil possibilities cannot easily be overstated. Yet as the holding corporation system has been developing, publicity has been diminishing. The annual report becomes a formality. The opportunities for examination even of the stock transfer book are restricted. The courts treat every inquiring stockholder with hostility, and by-laws practically prevent his examination of the corporate accounts unless he is able to establish a *prima facie* case of misfeasance which could as well be established without such examination. Other contemporaneous legislation and by-law development reduce within the narrowest limits the liability of directors, and increase the facility by which common stock may be subjected to an issue of preferred, and preferred stock to a new issue of bonds. The board of directors is classified so that it is as difficult to oust the management at an election as it is to amend the Constitution of a State. These evils are not peculiar to, but intensified in, the holding corporation.

The conditions incident to a great "trust," and particularly to a great holding corporation, are peculiarly unfavorable to the ancient and once powerful weapon of the minority stockholder—the stockholders' suit in equity for the redress of oppression and wrong. I have already alluded to the practical impediment to an action for an accounting due to the protection which legislatures and courts give to insiders' secrets. Often the most important rights of the minority stockholder, however, are lost unless they can be protected by an injunction suit. The action of the insiders must be prevented, or it will be irretrievable. When a grand stroke is contemplated by the insiders in their own interest—and within a few weeks it has been testified under oath in a court of justice that $46,000,000 was made by them as the "rake off" in a single deal, as a result of which probably thousands of families were impoverished—the plans are laid after a long period, sometimes a year, of preparation, during which a majority of the outstanding stock is accumulated upon the market. Then suddenly the new plan—stock purchase, stock sale, lease, consolidation, bond issue, or what not—is announced, and the shortest possible time given before the stockholders' meeting at which it is to be passed upon. A considerable portion of ignorant stockholders can be relied upon to give their proxies blindly to the management, unless circularized by a protective committee to the contrary, and there is no time intelligently to procure the necessary information for such a circular. The expense involved in a properly conducted stockholders' suit is enormous. If questions of fact must be tried, it is prohibitory to anything but a large combination. Many are afraid to oppose the leaders of the speculating community. There are brokers whose customers would be ruined if their credit was cut off by the banks. There are business men who are subject to discrimination. They fear punishment in various ways. Some are actually threatened. Those who would naturally be willing to join in an action are not only in the dark as to the real facts, but in the dark as to where to find each other out. They lack the power to form an effective combination within the time allowed, and each stockholder separately lacks the capital requisite to a successful appeal to the courts. There is no possible way open to the complainant of getting reimbursement except by selling his stock to the defendants (which destroys the value of the suit to the other stockholders), or by speculating on the market. The institution of the suit generally causes the stock to fall in price, although the object of the suit, and its result if successful, would be largely to increase the stock's market, as well as its intrinsic value. The suit therefore is treated by the public as an injury to the company, and is correspondingly unpopular. And in fact the first suit is commonly brought by a speculator—often by an adventurer as unprincipled as the promoters whom he is suing. If well conceived and ably pressed, the latter generally settle it; and before the public have realized that it is settled, the promoters' scheme is put through and the thing is all over. Sometimes, however, the suit is collusive, or foolishly and ignorantly managed. In these cases a decision of the court is obtained which it is impossible for the wiser and more deliberate stockholders subsequently to overthrow. Whether he is right or wrong, honest or dishonest, wise or otherwise, the complainant is accused of blackmail, and a large section of the press used for the destruction of his character and the cutting off of reinforcements. His witnesses may be terrorized. Himself and his counsel may be boycotted. Such contributions as he receives toward his expenses come anonymously. When he gets into open court, he is subjected like other litigants to narrow time limitation for his argument; and most of his time is used up in disproving false charges and showing his own good faith. He finds that a false atmosphere has been cast about his case; and he is unable to surmount the practical difficulties which impede his path. Of course there are notable exceptions to this general history of the stockholders' suit, where the insiders are men comparatively weak, the outsiders men comparatively strong, and the season one when the suspicions of the press and of the public have been aroused. These are now the exceptions, however, and not the rule.

Even the natural impediments to stockholders' suits, however, are not deemed sufficient by the trust magnates of to-day in the principal promoting State. Strong effort is now being annually made to procure legislation which would require the joinder as complainants of a practically impossible amount of stock, and the filing by the complainants of a bond impossibly large. Although strongly backed by the governor, the legislation has not yet been adopted, but the strength of its support shows the fact that the public are not as yet aroused to the true causes of the growth of the modern monopoly, but blindly allow them full operation while vainly endeavoring to obtain practical effects by enforcing such spectacular but inefficient remedies as the present anti-trust laws, which do not attack it until it has reached a late stage of its growth.

The right way to remove an evil is to remove its cause. Account books should be opened, not closed. It should be a criminal act for a director to speculate in the stock of his own company. He should be held as strictly to his duty as is the executor or trustee under a will. He should account to the company for all profits made by him as a result of secret information. He should be responsible for all damage caused to the investor by any prospectus, report or public statement whose issuance and whose falsity he should have known.

Furthermore, the holding corporation is the most effective instrument of over-capitalization, with the consequent injury to the public interest. It is the favorite method of capitalizing the unearned increment coming to a public service company as a great city grows in population. As fast as the street railroad company's, or the gas company's, or the electrical company's earnings thus increase, its old stock is converted into bonds and new stock issued to represent that increment. The new stock is sold to the public, with fabulous profits for the syndicate managers. Legislative regulation of rates is then resisted on the ground that the unfortunate stockholders would lose their dividends. The State is put into a dilemma in which it ought not to be—a dilemma between doing justice to the public who have made the increment, and doing mercy to the ignorant stockholders who have invested their savings in the new stock. The profit of the promoters is unreachable.

And finally, the moral influence of these aggregations is not good. The stockholding corporation is an invention of stock speculators, and its origin and history are generally accompanied with phenomena of the stock market. The old-fashioned merchant prince, the more recent captain of actual industry, was a man with many qualities which afforded a valuable example to his fellow citizens. The multi-millionaire of gas and electricity, of street railroads, of steel and copper, performs no such function. The successful leader in an enterprise whose profit is made by shuffling corporations and dealing them in Wall street is not the most industrious or even the ablest man among his fellows. He is indeed not the most unscrupulous; but he is the man who happens to combine a certain high degree of ability with a certain fortunate balance between unscrupulousness and respectability, a balance which his disciples seek to emulate. The holding corporation tends more than any other agency to develop individual wealth in a very few individuals, for wealth is more rapidly made in turns and deals than in salaries, in dividends, or in the appreciation of genuine stock values. The fortunes thus made are not normal, and are not necessary as goals to incite human industry or ambition. Seeing the power, political, social and individual, which thus comes to a few individuals, tends to turn the public from the traditions of democracy to those of socialism.

TECHNICAL.

Manufacturing and Business.

The Train Order Protector & Signal Lock Co. has been incorporated at Nashville, Tenn., to make machines for protecting train orders and for signal locks by F. E. Draper, F. J. Zoller and others.

The Jacobs Car Co., of Chicago, is considering an offer of the Commercial Club, of Paris, Ill., to give 30 acres of ground and lend the company $150,000 as an inducement to build shops at that place.

Mr. C. D. Whitney, formerly General Traffic Manager of the Clover Leaf, is now President and General Manager of the Toledo (Ohio) Bronze Company, makers of brass, bronze and aluminum castings.

C. L. Day, Division Freight Agent of the American Steel & Wire Co., is to be transferred from Cleveland to Chicago, and J. A. Coakley, formerly in Pittsburg, will go to Cleveland. R. S. Davis will succeed Mr. Coakley.

The Chicago Rail Joint Company has been incorporated in Illinois with a capital of $25,000 to make railroad appliances and supplies, by C. W. Dickey, J. F. Rowley and T. G. McElligott.

John F. Allen riveting machines have been sold lately to Worden-Allen Co., Milwaukee; Brookville Bridge Works, Brookville, Ohio; American Car & Foundry Co., Berwick, Pa.; Mt. Vernon Bridge Co., Mt. Vernon, Ohio; Pennsylvania Steel Co., Steelton, Pa.; Portland Co., Portland, Me., and to other well-known concerns.

The American Bridge Co. has received a contract from the Atlanta Terminal Railroad for the structural work of the union station to be 750 ft. long, 250 ft. wide, with a turtle-shaped roof; also for several small overhead bridges to be built in connection with the elevated tracks running into the new station. The work is to be begun at once.

N. & G. Taylor Co. reports an active demand for "Taylor Old Style" brand of roofing tin, which is in marked contrast to the general conditions prevailing in the iron and steel trade. Both of the company's plants, at Philadelphia and at Cumberland, Md., are running full time, and extra shifts are contemplated. Improvements recently made at both works have enabled the output to be greatly increased.

Charles M. Schwab has resigned as a director of the International Nickel Company, and, with his brother, Joseph H. Schwab, has sold his holdings in the company, which is controlled by the Orford Copper Co. The Orford has been largely interested in introducing the use of nickel in steel manufacture. These stock holdings have been taken by E. C. Converse, of Philadelphia, and other large stockholders of the company.

The Barberton City Water Works of Barberton, near Akron, Ohio, has ordered from the Pneumatic Engineering Company a complete air lift plant for its new group of 12 wells. The air compressor in the new pumping station will be about 1,500 ft. from the wells. It is a Rand compound condensing, type 10, having steam cylinders 10 in. and 18 in. x 14 in., and duplex air cylinders 14 in. x 14 in. The equipment includes a surface condenser, air receiver, and the usual piping. The capacity will be three million gallons a day. It is expected to have the entire plant in running order by the middle of August.

C. C. Tyler has resigned as Superintendent of the works of the Westinghouse Electric & Manufacturing Co. at East Pittsburg, Pa., and has been appointed General Superintendent of all the works of the Allis-Chalmers-Bullock interests in the United States. Mr. Tyler will enter upon his new duties June 15th, and will make his headquarters at Milwaukee. His record in the practical management of great machine shops is one of the best in the country. He has been at Pittsburg six years, and has increased the efficiency of the Westinghouse electric works. In the equipment, design and management Mr. Tyler is recognized as an expert of the first grade.

Iron and Steel.

The Carnegie mills, Conneaut, Ohio, are sending 40,000 tons of rails to the Canadian Northern.

The negotiations under way for the past six months to consolidate the Sloss-Sheffield Co., the Tennessee Coal & Iron Co. and the Republic Iron & Steel Co., the three largest iron companies in the South, it is reported, have been abandoned.

The exports of iron and steel from this country in the ten months ending with last April, as reported by the Department of Commerce and Labor, amounted to $89,694,415, as against $79,839,462 in the corresponding months of the preceding year, an increase of over nine millions. April alone shows an increase of $1,500,000. The imports during these ten months show a diminution of from 43 millions to 23, pig iron alone having fallen off more than ten millions. Exports of locomotives, chiefly to Canada and Mexico, increased in the ten months from $2,998,491 to $3,947,225.

Competition for orders for steel finished material results in the shading of prices. One sale of plates which has just been told of is for 400 tons delivered at Callao, S. A., which order was taken at 1.42½c delivered, equivalent to $21.85 per ton f. o. b. mill Pittsburg. Domestic business is being taken at lower prices. The Pressed Steel Car Company has secured orders from Pacific Coast lines, from the Illinois Central, the Seaboard Air Line and the Chicago, Lake Shore & Eastern. Independent plate mills in the East are running only from two to four days in the week because of the light business.

A Signal Test.

Mr. R. Herman, of Crafton, Pa., who has designed a new type of motor for semaphore signals, lately made a test of one of the new signals and it worked 74,100 times on a battery of 300 ampere-hour cells. The movement of the signal arm is 90 deg. and it was made to work 1,400 times a day of 24 hours. This motor and its enclosure are designed to go on the top of the signal post, and the blade is connected directly to the motor. The Gordon battery was used.

Triplex Air-Brake Gage.

An improved form of triplex air-brake gage is being made and sold by the Standard Gauge Manufacturing Company, Syracuse, N. Y. It registers on one dial the reservoir pressure, shown by the red hand; the train line pressure, shown by the black hand, and the brake cylinder pressure shown by a short hand reading over a graduated arc of smaller diameter than the train line and reservoir indication. The red and black hands show readings from 0 to 200 lbs., and the brake cylinder hand shows pressures up to 100 lbs. This gage is particularly adapted for locomotives as it takes the place of a duplex and a single hand gage and saves the space required by one of them. All of the readings show on one dial and the engineer can tell at a glance whether the brakes are applying on the engine and whether the pressure is holding. At night the face of the dial is well lighted up by the cab lamp which is not the case where two gages are used and where one is mounted some distance to one side of the lamp. The gage is made with a 5-in. dial face and is mounted in a finished brass case.

New Corning Plant of the T. H. Symington Co.

On May 13, 1904, the Corning, N. Y., plant of the American Brake Shoe & Foundry Company was sold to The T. H. Symington Company, and the latter company will from now on operate it exclusively for making Symington journal boxes and other devices which it controls. This will enable it to guarantee absolutely the quality of material and workmanship of the product. This foundry was originally known as the Corning Iron Works, and was engaged in the making and selling of miscellaneous castings as early as 1883. It was taken over by the American Brake Shoe & Foundry Company in 1902. For the past year is has been devoted exclusively to the manufacture of Symington material, and was well equipped as a journal box foundry, the equipment having been designed and put in under the direction of the mechanical department of The T. H. Symington Company. The output of the foundry has lately been doubled by the addition of a second 72-in. cupola. This addition gives a capacity of 60 tons of iron daily, or about 1,200 to 1,400 journal boxes. The molding machines, metal patterns and core making devices used have been specially designed with a view to obtaining accurate and well-made castings, as well as a large output per man. A Rockwell oil-burning annealing furnace of large capacity is used to anneal all boxes before passage to the cleaning room, where every casting is carefully inspected for defects and gauged at essential points. From the cleaning room the boxes pass to a combined machining, assembling and shipping room. The machining necessary on the joint of lid and box is done on specially designed milling machines. These machines are close to the shipping platform, so that boxes coming off the machines go immediately to this platform; lids are attached and dust guards inserted and the boxes are transferred directly into cars for shipment.

THE SCRAP HEAP.

Notes.

A compartment sleeping car is to be run between New York and St. Louis on the South Western Limited of the New York Central and the Big Four.

The Railroad Commission of Texas has ordered the railroads of the State to make to it monthly reports of interlocking plants at railroad crossings, showing the condition of the apparatus and the character and extent of accidents, if any.

A member of the Canadian Parliament recently complained that in employing engineers to survey for the Grand Trunk Pacific, men from the United States were being favored; and in consequence of the agitation thus started, the government appointed a commissioner to inquire and report the facts. The commissioner, Judge Winchester, of Toronto, having taken evidence finds that the engineer in charge of the surveys, Mr. J. R. Stephens, is an American, who was appointed after the position had been offered to a Canadian and refused. Mr. Stephens testified that engineers were chosen solely on their merits, without regard to nationality; and that there are very few Americans engaged on the work. Some people in Canada think this outcry is rather inconsistent, for strenuous efforts and large expenditures are being made to encourage immigration from the United States.

In the investigation of a complaint against the Armour Car Line at Chicago, last week, by the Interstate Commerce Commission, evidence was given to show exorbitant charges for icing fruit carried in the Armour cars, and it is given out that the commission will make a thorough investigation into the private car industry throughout the country, with a view to seeing if railroads ought not to be required to furnish enough refrigerator cars for the perishable traffic over their lines. It is said that Mr. J. W. Midgley, who has gathered a large amount of data concerning private cars, is to provide "ammunition" for the commission's investigation. The president of a Michigan fruit growers' association testified that the price of icing a car going from Michigan to Dubuque, Iowa, had been raised from $7.50 to $37.50. Another witness said that the icing charges in Armour cars some times amounted to one-third as much as the bills for transportation. From Sparta, Mich., to Indianapolis, Ind., the increase in the cost of icing has been 37 per cent. On a 15-ton shipment of fruit to Boston, the freight is $237 and the icing $55.

Manchester Ship Canal Improvement.

The Bill for deepening the canal by 2 ft., and for carrying other improvement works has been passed by the Select Committee of the House of Lords, with the addition of a clause giving large powers of control to the Mersey Conservator to ensure the protection of the estuary. The Conservancy will have enlarged control over the sluicing; will be entitled to returns of the water discharged from the canal and the places of discharge, and will have the discharge of the water under its control.

World's Railway Congress.

The executive committee of the American Railway Association, which is substantially the executive committee of the American Section of the International Railway Congress, met at Washington, D. C., on June 1 and considered the arrangements for the Congress which is to be held in Washington next year. All of the members were present. May 3 was fixed as the day for registering delegates, and daily sessions will be held from then until May 13. The foreign delegates will be invited to visit Pittsburg, Chicago, St. Louis, and other cities, and an itinerary for this tour was discussed.

Electric Mountain Railway in Wales.

An undertaking of more than usual interest to English engineers because of the lack of water power in the United Kingdom, is the project of the North Wales Electric Traction & Power Co., which has just succeeded in passing its bill through the Parliamentary committee stage. The waters of Llyn Llydaw on the eastern slopes of Snowdon are to be utilized in the generation of 12,000 h.p., a portion of which will be employed in the electrical operation of the Snowdon, Portmadoc & Beddgelert Railway, which is now building. It is only in a few exceptional cases that the Parliamentary authorities have permitted the use of overhead transmission lines in the United Kingdom, but the recent agitation in this direction has borne some fruit, and in the present case such lines have been allowed. The engineering evidence showed that unless they were sanctioned there could be little hope of financial success accompanying the scheme. Sir Douglas Fox and partners are the engineers, together with Messrs. Harper Bros., of London.

Rebuilding the Burned Piers of the Lackawanna at Hoboken.

Plans are already being made for rebuilding the piers of the Lackawanna which were destroyed by fire on Sunday, May 29. The new pier on which the McMyler car dumping machine was mounted was badly damaged from a point just inshore from the machine to within about 50 ft. of the bulkhead line. Most of the piles will have to be capped and a new floor laid. The car dumping machine was only slightly damaged and will be ready for operation as soon as the pier on which it stands has been rebuilt. The two piers to the south carried coal pockets and these were burned to the water's edge. The old piles will be removed and one modern pier with another car dumping machine will be built on the site. This work will probably be finished by fall in time to handle the winter shipments of coal. One new single story shed and pier will be built on the site of piers Nos. 11 and 12. While the work of rebuilding is going on the Lackawanna is using the Delaware & Hudson coal piers further up the river at Weehawken. These piers have been idle since the coal strike two years ago. Cars are taken in from the Lackawanna over the Erie tracks.

Paris Underground Electric Railway.

From the figures which have now been issued respecting the working of the Paris Metropolitan Railway during the past twelve months, we are able to judge what was the effect upon the immediate business of the system, of the fire and scare, which ended so disastrously, in August, 1903. The resultant loss of traffic is placed at about £32,000, and the sums paid in respect of compensation claims total out at £46,000. These two items did not, however, prevent the payment of dividends, for shareholders have received 3 per cent. plus an extra bonus of 7½ francs per £10 share. The company has to pay a large proportion of its traffic income over to the city municipal authorities, and the present account places this sum at £227,700, out of a total income of £704,700. The working expenses have been 42 per cent. of the receipts, or £303,100; so that over £174,000 remained disposable for dividends, reserve funds, etc. At the meeting of the company, quite naturally, considerable attention was paid to the alterations which have been undertaken, since the calamity, in regard to rolling stock, the isolation of electrical equipments on the trains, the establishing of a lighting circuit which shall be quite distinct from the power circuit in the tunnels and stations, and the provision of additional exits. To meet complaints of draughty

trains, a new system of ventilation on the lantern principle is being installed. The company does not propose to alter its attitude toward "smoking" in the trains, which is that of prohibition. The new power station, whose plant of some 15,000 kilowatts capacity will be adequate to supply the entire undertaking, is on the verge of completion, and as an additional safeguard, we understand that such arrangements have been made that in the event of additional power being necessary, it can be obtained with facility from outside sources.

Air-Compressor Construction Car—Lackawanna.

The Lackawanna has designed an air compressor car which can be placed to one side of the main track without the necessity of building a spur track near the bridge or structure which is being built or repaired. Under each corner of the car is hinged a screw-jack. These jacks reach within 8 or 10 in. of the ground, and in order to raise the car, blocking is placed beneath the jacks. When it is desired to remove the car from the main track, the car is first raised a few inches by means of the jacks and blocks. The center pins of the trucks have nuts on their lower ends so that the trucks raise with the car. As soon as the truck wheels are clear of the rails, each truck is turned at right angles to the main track. The car is then lowered on short sections of rails and is pushed off to one side to the desired position. This entire operation requires but 20 minutes. All blocking and rail sections are carried on the car. The car is the standard box type, 40 ft. long, and reinforced to withstand the severe strains due to jacking. The car is equipped with a 22 h.p. Otto gasoline engine which is connected to a No. 11 Rand air compressor. The car is also fitted with gasoline, water and air reservoirs. A complete complement of air tools, pipes, fittings, etc., used on steel construction work is carried. We are indebted to W. B. Hixson, Superintendent of Bridges and Buildings, for the above details.

Damage Suit Industry in Texas.

Few people, even residents of Texas, have a conception of the magnitude to which the "damage suit industry" in that State has attained. A few years ago the amount of money paid out yearly by the railroads of Texas was not large and did not excite alarm. But step by step, in ever increasing progression, the list of suits and the amounts of damages became bigger and longer. A mistaken public sentiment that permitted, if it did not justify, this practice, became prevalent in several communities of the State. Damage suits against railroads seemed to become a fad. There were lawyers who pleaded cases of this kind, and juries granted heavy damages against a railroad just because it was such, and on the flimsiest of pretexts. The total amount of damages the railroads were forced to pay grew to startling proportions. With a large proportion of its revenues going out in personal injury claims and attorneys' fees, there was not a railroad company doing business in Texas that felt free to extend its lines into any territory, no matter how desirable it might be. It is true, that the State's railroad mileage has been largely increased and the service of every line bettered since damage suits became a regular business, but the fear that these claims might stand as a barrier against improvement has been in the thoughts of all the railroad men of Texas for a decade. The fear still prevails. It will be present in dominating force till the public sentiment of Texas justifies only just claims against railroads and until the professional damage suit attorney is forced into another and more legitimate line of work. One need not deal in generalities as to the losses suffered during the last thirteen years. The records of the Railroad Commission at Austin tell how this business has benefited a few at the expense of the general public as well as of the railroads.

In 1891 Texas railroads paid out on account of real and alleged personal injuries the modest sum of $223,750. A year later this personal injury fund was swollen to $284,727; in 1893, $295,043; in 1894, $333,339; in 1895, $464,769; in 1896, $487,403; in 1897, $472,800; in 1898, $586,646; in 1899, $655,739; in 1900, $1,018,638; in 1901, $1,457,973; in 1902, $1,765,653, and last year these railroad losses reached the stupendous figure of $1,940,551. Two million dollars is a big item in the expense account of the Texas railroads. The total of the general expenses of the Texas lines for 1903 is just slightly in excess of what the damage suit business cost them. Two million dollars would build many miles of new lines. It would go far toward bettering equipment and service on all lines. It is idle to pretend that facts warranted this immense outlay. —*Austin Statesman.*

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page 16.)

Saratoga Conventions.

The United States Hotel will open June 20 to accommodate members and guests of the M. C. B. and A. R. M. M. conventions. The hotel is but a short walk from headquarters and near the hall in which the meetings are to be held. Rooms may be reserved by addressing the owners, Messrs. Gage & Perry, Saratoga Springs, N. Y.

Pacific Coast Railway Club.

At the meeting of this club in San Francisco, May 21, the following officers were elected: President, H. Engelbright (S. P.); First Vice-President, E. L. Braswell (North Shore R. R.); Second Vice-President, W. H. Doble; Third Vice-President, J. C. Wilder (S. P.); Fourth Vice-President, D. P. Kellogg; Secretary and Treasurer, C. C. Borton (S. P.); Executive Committee, H. J. Smith, P. Sheedy (S. P.), W. H. Russell (S. P.), J. H. Wallace (S. P.), and W. S. Palmer (S. P.).

Freight Claim Association.

At the thirteenth annual convention of this association recently held in Savannah 140 lines were represented. The Secretary's report showed an addition of 31 members during the year, making the total membership 240. The number of claims handled by the present Arbitration Committee has been 57, from which there were but seven appeals, two of which were granted and referred to the standing committee of seven, five denied and one referred to the standing committee of five. The officers elected for the ensuing year were: President, M. L. Becker (Wabash), St. Louis; First Vice-President, L. Calkins (N. Y. C. & H. R.), New York; Second Vice-President, Joseph F. Gray (C. of G.), Savannah, Ga.; Secretary and Treasurer, W. P. Taylor (R. F. & P.), Richmond, Va. The next meeting will be held in Philadelphia, May 17, 1905.

PERSONAL.

—Mr. J. A. L. Waddell received the degree of Doctor of Laws from Missouri State University at the Commencement exercises, on the first of June.

—Mr. William Keyser, for many years Second Vice-President of the Baltimore & Ohio, died at Baltimore, June 3. Mr. Keyser was 69 years old, and was at one time President of the Baltimore Copper Rolling & Smelting Company.

—Mr. William T. Eldridge, Vice-President, General Manager and General Freight and Passenger Agent of the Cane Belt Railroad, was shot by an assassin while entering his office at Eagle Lake, Texas, on June 6, and at last accounts was lying at the point of death.

—Mr. George W. Davis, of Toledo, Ohio, who died in that city June 2, at the age of 83, was one of the pioneer business men of the west. He was the contractor for the construction of the Wabash Railroad between Toledo and Logansport, and was one of the organizers of the Canada Southern.

—Mr. George Alexander, for many years on the Chicago, Burlington & Quincy, died at Aurora, Ill., on May 21, at the age of 77. Mr. Alexander occupied various subordinate positions, until June, 1880, when he was appointed General Superintendent of the Chicago & Iowa, and when that road was acquired by the Chicago, Burlington & Quincy he returned to the Burlington as Division Superintendent.

—Mr. Morton Riddle, Jr., the new Assistant Chief Engineer of the Atlantic Coast Line, was born in Petersburg, Va., in 1869. His first position on the Atlantic Coast Line was that of Roadmaster, which he held for ten years. At the end of this time (November, 1901) he was appointed Superintendent of the Richmond District, which position he has held until his present promotion.

—Mr. John T. Paul, until recently Superintendent of the Memphis Division of the Yazoo & Mississippi Valley, died May 24, at the age of 49. Mr. Paul began his railroad work as a trainmaster for this company at Memphis, and subsequently became trainmaster for the New Orleans & Mississippi Valley Terminals, at New Orleans, in 1895. In 1902 he went to Memphis as Superintendent of the Yazoo & Mississippi Valley.

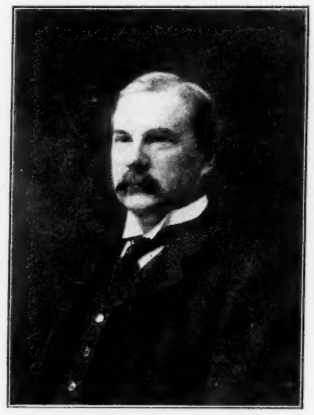
—Mr. J. P. Russell, who succeeds Mr. Riddle as Superintendent of the Richmond District of the Atlantic Coast Line, has been in the service of this company for the past 19 years. He began in the baggage department and served in various subordinate positions until 1900, when he was made chief clerk to the General Manager. Two years later he was made Fire Insurance Agent, from which position he is now promoted to be Superintendent at Richmond.

—Mr. David R. Fraser, who died in Chicago recently at the age of 80, was called the pioneer machinery manufacturer of Chicago. He is said to have built the first locomotive made there, delivering it to the Galena & Chicago by hauling it over the plank road from Adams to Kinzie Street. In 1872 he organized the firm of Fraser-Chalmers, which later became the Allis-Chalmers Co. Mr. Fraser was the inventor of machines which helped to revolutionize the mining industry.

—Mr. R. Gaunt, Superintendent of Transportation of the St. Louis, Watkins & Gulf, was born in Detroit, Mich. His first railroad work was on the Michigan Central and Canada Southern as a fireman and brakeman. Mr. Gaunt spent 20 years (with the exception of one year when he was on the Canadian Pacific) on the International & Great Northern, in Texas, filling various subordinate positions until 1886, when he was made roadmaster. In 1898 he resigned and went to the St. Louis, Watkins & Gulf, and has since been with that company.

—Mr. John G. Brady, formerly for many years Master Mechanic of the Worcester & Nashua; died in New York City on May 27. Mr. Brady was born in Norwich, Conn., in 1833, and began his railroad service on the Norwich & Worcester, where he was a locomotive engineer and shop foreman. For a time he was Master Mechanic of the Portland & Rochester, at Portland, Me., and he went from there to the Worcester & Nashua, where he served in the same capacity. Mr. Brady was Water Commissioner of the city of Worcester at the time of his death.

—Mr. Albert J. Pitkin, who on Monday of this week was chosen to succeed the late Mr. Callaway as President of the American Locomotive Company, was born near Akron, Ohio, and is 50 years old. Mr. Pitkin's early life was spent in Illinois, his father being a Presbyterian Home Missionary. After a public school education at Granville and Akron he worked for the Webster, Camp & Lane Machine Company and afterward as a machinist in the shops of the Cleveland, Akron & Columbus. Then for about five years he was with the Baldwin Locomotive Works at Philadelphia and went to Providence, where he served for two years as Mechanical Engineer for the Rhode Island Locomotive Works. In 1882 he went to the Schenectady Locomotive Works, and after two years was made Superintendent. Not long after this he was promoted to be Vice-President and General Manager, which place he held until the Schenectady Locomotive Works was acquired by the American Locomotive Company, at which time Mr. Pitkin was elected First Vice-President of the new company, and from which position he is now promoted to be the head of the company. Mr. Pitkin's last promotion is of a kind that is peculiarly gratifying to professional men—one of the too infrequent instances where a purely scientific student and designer and investigator develops in addition the ability to control men, and that still higher capacity for broad views and the guidance of the affairs of a great corporation.



—Mr. C. L. Leslie, formerly for a number of years Auditor of the Wiggins Ferry Company, died at his home in St. Louis, May 30. Mr. Leslie had served on the Kansas Pacific, the Atchison, Topeka & Santa Fe, the Union Pacific, the International & Great Northern and other roads.

—Mr. M. F. Bonzano, Chief Engineer of the Pittsburg, Shawmut & Northern, has resigned that position. He has made no engagement for the future and expects to take a short vacation. Mr. Bonzano has been at the head of the engineering department of the P., S. & N., about two years and a half, and during that time a large amount of new work has been done. The new extensions are of the most substantial character and a considerable portion of the company's freight traffic is now being handled by locomotives having 186,000 lbs. on the driving wheels.

—Mr. Y. van den Berg, who succeeds Mr. Hershey as Assistant General Freight Agent of the Gulf, Colorado & Santa Fe, at Galveston, is a native of Amsterdam, Holland, and was educated at the University of Leyden. He entered railroad service in 1881 and served in various positions in the traffic department of the Baltimore & Ohio and the Louisville & Nashville. From 1891 to 1892 he was General Freight Agent of the Louisville & Nashville, and in January of the latter year he was made Traffic Manager. After serving in that capacity for a number of years he resigned to go into other business, and has lived in Baltimore for several years past.

—Mr. W. B. Scott, the new General Superintendent of the Houston & Texas Central and the Houston, East & West Texas, was born in Hamilton, Ont., in 1862, and was educated at Martin's Academy, at Guelph, Ont. His early railroad service was as a messenger on the Grand Trunk, on which road he served in various positions from 1873 until 1883. Then for four years he was train despatcher for the Canadian Pacific, at Winnipeg, and for two years from 1887 was chief train despatcher and trainmaster on the Great Northern. In the latter year he was made Superintendent of Telegraph of the Chicago Great Western, and in 1890 was appointed trainmaster on the Atchison, Topeka & Santa Fe, at Chicago. This position he held for seven years, and at the end of that time was appointed Superintendent of the Gulf, Colorado & Santa Fe, at Temple, Texas. Mr. Scott also served for a time with the Gal-

veston, Harrisburg & San Antonio. He assumed his present duties on June 1.

—Mr. John Scofield Hershey, whose promotion to be General Freight Agent of the Gulf, Colorado & Santa Fe to succeed Mr. Goodwyn, was recently announced, is a native of Nebraska. He began as a clerk for the Chicago, Burlington & Quincy, at Chicago, and later was in the auditing department of the Elgin, Joliet & Eastern. In 1896 he resigned as rate clerk to go to the Atchison, Topeka & Santa Fe, where for six years he worked in the office of the Freight Traffic Manager. In 1902 he went to Beaumont, Texas, as General Freight and Passenger Agent for the Gulf, Beaumont & Kansas City, where he remained for about five months, and then went to Galveston as Assistant General Freight Agent of the Gulf, Colorado & Santa Fe, under General Freight Agent P. H. Goodwyn, whom he now succeeds.

ELECTIONS AND APPOINTMENTS.

Boston & Albany.—J. M. Fitzgerald has been appointed Signal Engineer, with office at Boston, Mass., succeeding Azel Ames, Jr., resigned. (See Lake Shore & Michigan Southern.)

Burlington & Missouri River in Nebraska.—C. L. Eaton has been appointed Assistant Superintendent of Transportation. The position of Assistant Superintendent of Special Car Service, heretofore held by him, has been abolished. Mr. Eaton's office will be at Lincoln, with jurisdiction over lines west of the Missouri river.

Canadian Pacific.—J. S. Lawrence has been appointed Superintendent of District three, succeeding F. F. Busteed, promoted.

Central Ontario.—S. J. Ritchie has been elected President.

Chicago & Eastern Illinois.—See St. Louis & San Francisco.

Chicago & North-Western.—H. C. Mahanna, District Superintendent at Fremont, Neb., has resigned.

Chicago, Burlington & Quincy.—The jurisdiction of F. A. Delano, General Manager of the C., B. & Q., has been extended over all Burlington lines east of the Missouri River. This evidently includes the Hannibal & St. Joseph, the St. Louis, Keokuk & Northwestern, and the other Burlington lines heretofore under the jurisdiction of a General Manager at St. Louis. The title of W. L. Barnes has been changed from Superintendent of Car Service to Superintendent of Transportation, the old title being abolished.

Denver & Rio Grande.—J. B. Andrews has been appointed Assistant to Vice-President C. H. Schlacks, with office at Denver.

Erie.—W. A. Baldwin has been appointed Division Engineer, with headquarters at Elmira, N. Y., succeeding E. H. Johnson, resigned; and J. T. Taffany has been appointed Division Engineer at Dunmore, Pa., to succeed Mr. Baldwin.

Gulf, Colorado & Santa Fe.—W. C. Nixon, General Manager, has been appointed Second Vice-President also, succeeding L. J. Polk, resigned.

Hannibal & St. Joseph.—(See Chicago, Burlington & Quincy.)

Illinois Central.—F. H. Harwood has been appointed Coal Traffic Manager, with office at Chicago, succeeding C. F. Parker; and William Smith, Jr., has been appointed Assistant General Freight Agent at Evansville, Ind., to succeed Mr. Harwood.

Iowa Central.—J. A. Davis, Superintendent, with office at Oskaloosa, Iowa, has resigned.

Lake Shore & Michigan Southern.—Azel Ames, Jr., has been appointed Signal Engineer, with office at Cleveland, Ohio. E. D. Wileman is now Assistant Signal Engineer.

Lehigh Valley.—J. H. Fildes has been appointed Master Mechanic, with headquarters at Buffalo, N. Y. Thomas Coyle, hitherto General Foreman at Perth Amboy, has been appointed to succeed Mr. Fildes as Master Mechanic of the Mahanoy & Hazleton Division, with headquarters at Weatherly, Pa.

Pittsburg, Shawmut & Northern.—M. F. Bonzano, Chief Engineer, has resigned.

St. Louis & San Francisco.—A. J. Davidson (President) has been elected a Director, succeeding J. A. Blair, resigned.

The jurisdiction of J. F. Hinckley, Chief Engineer, has been extended over the Chicago & Eastern Illinois. W. S. Dawley has been appointed Engineer of Maintenance of Way of the C. & E. I. and the Third Division of the St. L. & S. F., which includes the St. Louis, Memphis & Southeastern.

Southern.—C. P. Adams has been appointed Superintendent of Telegraph, with headquarters at Washington, D. C., succeeding C. A. Darlton, resigned. Mr. Adams' jurisdiction extends over the St. Louis-Louisville Lines.

Toledo, St. Louis & Western.—W. D. Tucker has been appointed General Auditor, with headquarters at Toledo, Ohio, succeeding W. F. Booth, resigned.

E. S. Wortham has been appointed Purchasing Agent.

LOCOMOTIVE BUILDING.

The Gulf & Ship Island is having two locomotives built at the Baldwin Locomotive Works.

The Seaboard Air Line is reported to be having 10 locomotives built at the Baldwin Locomotive Works.

The Quebec Central is having two locomotives built by the Locomotive & Machine Co. of Montreal, Ltd.

The Chihuahua & Pacific has ordered two simple consolidation (2-8-0) locomotives from the American Locomotive Co. for delivery about July 21st. These locomotives will weigh 146,000 lbs., with 128,000 lbs. on drivers. Cylinders 19 in. x 26 in.; diameter of drivers, 50 in.; radial stayed wagon-top boiler with a working steam pressure of 200 lbs.; 256 charcoal iron tubes, 2 in. in diameter and 13 ft. 1 in. long. Fire-box, 108 x 42 in.; tank capacity, 5,500 gallons of water. Special equipment includes Westinghouse brakes; sectional magnesia boiler lagging; Sterlingworth brake beams; Standard Coupler Company's coupler; Schroeder headlights; Hancock injectors; Jerome piston rod packing; Coale safety valves; Leach sanding devices; Detroit sight-feed lubricators; Railway Steel-Spring Company's springs, and 30 in. cast iron wheels.

The Chesapeake & Ohio has ordered two simple Pacific (4-6-2) locomotives from the Richmond Works of the American Locomotive Co. These locomotives will weigh 205,600 lbs., with 145,850 lbs. on the drivers; cylinders, 22 in. x 28 in.; diameter of drivers, 72 in.; straight-top boiler, with a working steam pressure of 200 lbs.; heating surface, 3,521 sq. ft.; 310 Seamless steel tubes, 2¼ in. in diameter and 19 ft. 6 in. long; wide carbon steel fire-box, 90 in. long and 75 in. wide; grate area, 46.8 sq. ft.; tank capacity, 7,000 gallons of water, and coal capacity, nine tons. The special equipment includes: Westinghouse air-brakes, Gollmar bell ringer, Franklin magnesia boiler lagging, Diamond special brake-beams, "Perfecto" brake-shoes, Tower couplers, Pyle-National Electric headlights, Hancock injectors, Jerome piston and valve rod packings, Consolidated safety valves, Leach sanding devices, Nathan sight-feed lubricators, Railway Steel-Spring Co.'s springs, Crosby steam gages, Safety steam heat equipment, Latrobe driving, truck and tender wheel tires and cast-steel wheel centers.

CAR BUILDING.

The Harriman Lines are reported to have ordered 2,000 cars from the Pressed Steel Car Co.

The Colorado & Southern has ordered 12 box cars from the American Car & Foundry Co.

The Temiskaming & Northern has ordered 100 flat cars from the Crossen Co., Cobourg, Ont.

The New York Central & Hudson River has ordered two dining cars from Barney & Smith.

The Great Northern is in the market for 41 baggage, mail and express and express refrigerator cars.

The Ohio & Kentucky is reported in the market for one passenger coach, two cabooses and one combination car.

The Procter & Gamble Co., Cincinnati, is having 30 freights built at the McKees Rocks Works of the Pressed Steel Car Co.

The Cananea Consolidated Copper Co. is having six freight cars built at the St. Louis Works of the American Car & Foundry Co.

George W. Evans, Seattle, Wash., is in the market for five stock cars of 80,000 lbs. capacity and five box cars of 60,000 lbs. capacity.

The Colorado, Oklahoma & Southeastern is reported to be in the market for a number of box and flat cars and also for passenger equipment.

The Canadian Pacific is reported to have placed an order for 1,000 box cars at its shops at Angus, Que. For specifications of these cars see our issue of April 8.

The Halifax & South Western has ordered two first-class coaches, two second-class coaches and two baggage and mail cars from Rhodes, Curry & Co., for August delivery. The special equipment includes: Westinghouse air-brakes, Monarch couplers and Martin Car Heating Co.'s heating system.

The Illinois Central, as reported in our issue of May 27, has ordered 250 gondola cars of 100,000 lbs. capacity from the Pressed Steel Car Co., for August delivery, to be built of metal, with metal underframes. The special equipment includes: Pressed Steel Car Co.'s bolsters, M. C. B. cast-iron brake-shoes, Hewitt brasses, Buckeye steel couplers, Miner tandem draft rigging, Ryan dust guards, Woodman journal boxes and lids, Sherwin-Williams paint, Railway Steel-Spring Co.'s springs and Fox trucks.

The Canadian Northern, as reported in our issue of May 27, has ordered 500 standard box cars of 60,000 lbs. capacity and 25 refrigerator cars from Rhodes, Curry & Co., for June, July and August delivery. Both box and refrigerator cars will be 36 ft. 9¾ in. long, 9 ft. ¾ in. wide, and 7 ft. 10¾ in. high. The special equipment includes: Simplex bolsters and brake-beams, Westinghouse air-brakes, St. Thomas Brass Works' brasses, Monarch couplers, Miner draft rigging, M. C. B. journal boxes, Sterling paint, American Asphaltum Co.'s prepared roofs, and Rhodes, Curry & Co.'s wheels.

BRIDGE BUILDING.

BEAVER CITY, NEB.—It is reported that the County Commissioners are asking bids June 13 for building about five steel bridges.

BETHANY, MO.—Bids are wanted June 13 by C. F. Snyder, Bridge Commissioner, for building about 12 steel bridges in Harrison County.

BOSTON, MASS.—Bids are wanted June 13 by the Metropolitan Park Commission for building the superstructure and for the operating machinery and locks for two highway Scherzer rolling lift bridges; one over the Saugus River, Lynnway, and the other over the Malden River, Revere Beach Parkway.

CAIRO, ONT.—A steel bridge with concrete abutments will be built at Mosside. D. M. Smith, Cairo, can furnish particulars.

CLEVELAND, OHIO.—The New York, Chicago & St. Louis will build the substructures for all of its bridge work to be done this year, and has given contracts to the King Bridge Co. for the following superstructures: A double-track steel two-span bridge 185 ft. long over the St. Mary's River at Fort Wayne to cost $50,000; to remodel the old double-track iron span 185 ft. long into a single track with 30 and 60 ft. spans with plate girder bridges 335 ft. long over the Black River at Lorain to cost $20,000; to rebuild 60 ft. of the Rocky River viaduct over Rocky River with two 30-ft. spans to cost $5,000. The company is also building the Lorain draw-bridge over Black River, which is to be 342 ft. long; the Ashtabula viaduct 822 ft. 10 in. long and 106 ft. high, with single track; the Cuyahoga River viaduct in part 200 ft., and two double-track spans 200 ft. long over Scranton avenue and the C., C., C. & St. L. at Cleveland.

Bids are wanted June 22 by the Board of Commissioners for a bridge on Bliss road, in Euclid Township. Julius C. Dorn is Clerk.

DAYTON, OHIO.—Bids will soon be asked by the City Clerk for building the piers and abutments for the bridge over the Miami River at Herman avenue; also for the superstructure.

DENVER, COLO.—Plans, it is reported, are ready for building a bridge over Cherry Creek at Lawrence street to cost about $45,000.

FREDERICTON, N. B.—Bids are being asked by the Department of Public Works for rebuilding the Bailey creek bridge.

HAVRE DE GRACE, MD.—The Philadelphia, Baltimore & Washington, on June 6, awarded the contract to McMullen & McDermott, of Philadelphia, for building the piers and other masonry work for its double-track steel bridge to be built over the Susquehanna River. The contract calls for 20 piers, at least six of which must be built by the pneumatic process. It is expected that this work will require a year for its completion.

INDIANAPOLIS, IND.—The Cleveland, Cincinnati, Chicago & St. Louis has accepted plans for building approaches to its bridge over the Ohio River on the Indiana and Kentucky sides of the river. Work will be started at once.

LEXINGTON, MO.—Bids are wanted June 18 for building a steel bridge over Brushy Creek; also, on the same date, for building a steel bridge over Blackjack Creek. E. D. Weedin is Commissioner.

LONDON, ONT.—Bids are being asked by F. E. Robson, County Clerk, for building about nine bridges.

LOS ANGELES, CAL.—Bids are wanted July 18 by H. J. Lelande, City Clerk, for building a plate girder bridge over the Los Angeles River at Eliza street on concrete piers. The bridge is to consist of four spans each about 76 ft. long with a double track and with 20-ft. roadway and 5 ft. sidewalks.

NEWBERRY, S. C.—Bids will be asked June 30 by the County Commissioners for building a steel bridge over the Saluda River for the joint account of Newberry and Saluda counties.

NEW CASTLE JUNCTION, PA.—The Pittsburg & Lake Erie has given a contract to C. A. Sims, of Philadelphia, for the masonry work on its new double-track bridge over the Shenango River. The McClintic-Marshall Construction Co., of Pittsburg, has the contract for the steel superstructure.

OKLAHOMA CITY, OKLA. T.—Plans are being made by City Engineer Burke for stone or steel approaches to the Choctaw viaduct on Walnut street, to cost about $15,000.

PEMBINA, N. DAK.—Bids are wanted July 7 by the Board of County Commissioners for building about 11 steel bridges. S. Thorwaldsen is County Auditor.

PITTSBURG, PA.—A contract is reported let to Kerbaugh & Co., of Pittsburg, for building a stone bridge of two spans each 130 ft. long and 60 ft. high at a cost of about $200,000 to replace the present Lincoln avenue bridge.

LOS ANGELES, CAL.—Plans are being made for reconstructing the West Riverside bridge at a cost of about $21,000.

ST. CHARLES, MO.—Bids are wanted June 13 by Carr Edwards, County Surveyor, for building about eight bridges in St. Charles County.

STERLING, ILL.—A bridge will be built over Rock River to cost about $70,000. J. D. Arey is City Engineer.

WESTFIELD, MASS.—The town engineer is preparing plans for a new bridge at Pochassic street, over the New York, New Haven & Hartford Railroad.

Other Structures.

ASHEVILLE, N. C.—The Southern has accepted plans for the new passenger station here, and, it is reported, is asking bids for its construction.

BUFFALO, N. Y.—The Delaware, Lackawanna & Western, it is reported, will make extensive improvements, including a large freight house.

CHARLOTTE, N. C.—The city authorities have under consideration the question of accepting the proposition of the Southern to build a new passenger station to cost about $35,000.

CHICAGO, ILL.—A building permit has been taken out by the Metropolitan Elevated R. R. for building its down town terminal station which will be 87 x 95 ft., and cost $35,000.

DAVENPORT, IOWA.—The Chicago, Milwaukee & St. Paul, it is reported, is making plans for new repair and machine shops and extensions to its roundhouse.

HOBOKEN, N. J.—The Delaware, Lackawanna & Western is making plans for rebuilding the piers here which were destroyed by fire May 29.

MONTREAL, QUE.—The Locomotive & Machine Co., of Montreal, Ltd., now owned by the American Locomotive Co., will build additions to its structural shops also to its foundry at a cost of about $250,000.

NEW ALBANY, IND.—The Louisville & Southern Indiana Traction Co. has bought land on Third near Jefferson street as a site for its new terminal station.

NEW ALBANY, MISS.—Residents of this place are trying to raise a bonus to induce the Mobile, Jackson & Kansas City to build its general shops here at a cost of about $300,000.

ROANOKE, VA.—The Norfolk & Western, it is reported, has offered to build a new passenger station here.

WINNIPEG, MAN.—The plans for the Canadian Pacific combined hotel and station have been changed to make it a fire-proof structure throughout at an additional cost of about $200,000.

The Public Works Department has plans ready for a new immigration building to be 60 x 200 ft.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ALABAMA NORTHERN.—An officer writes confirming the report that a contract has been let to Wagnon Bros., of Anniston, Ala., for grading this railroad from Pyriton to Ashland, nine miles. Connection will be made with the Eastern of Alabama at Pyriton. The work is heavy, with maximum curves of 10 deg. and a maximum grade of 3 per cent. C. B. Allen, Ashland, Ala., is Chief Engineer. (May 27, p. 410.)

ARKANSAS RIVER & SOUTHERN.—A charter has been granted this company in Arkansas to build a railroad from Redemption, in Perry County, southeast to Maumelle, in Pulaski County, 20 miles. Connection will be made with the Choctaw, Oklahoma & Gulf at Maumelle. G. W. Perry, T. C. Bragg and B. Thurston are incorporators.

ATCHISON, TOPEKA & SANTA FE.—Press reports state that this company is now securing rights of way for a branch line from a point on the main line in the southern part of San Joaquin County, Cal., to Oakdale, where connection will be made with the Sierra Railroad.

BASIN & ELLISTON.—Press reports state that this company has let the contracts for grading and for masonry and bridge work on its proposed line from Basin, Mont., to Elliston, 20 miles. The road will connect with the Northern Pacific and the Great Northern, and will open up a mining district heretofore without railroad facilities. F. G. Lott, Basin, Mont., is General Manager. (See Construction Supplement.)

BODCAU VALLEY.—This company has been incorporated in Louisiana to build a railroad from Alden Bridge, Bossier County, east to Ivan, 10 miles. Connection will be made with the St. Louis Southwestern at Alden Bridge. H. H. Wells, Benton, La., is President.

BUFFALO, ROCHESTER & PITTSBURG.—An officer writes that the work which is now being done on the Big Run branch consists in laying track on the grade laid several years ago along Big Run at Newcastle, in order to reach the new cement plant located at that point. There are no new towns on the line, the greater portion of it being located in the City of Newcastle. Track laying is being done by the company's forces. (June 3, p. 430.)

CACHE RIVER VALLEY.—This company has filed an amendment to its charter providing for an extension from Walnut Ridge, Ark., in an easterly direction to Paragould, 25 miles. H. A. Culver, Sedgwick, Ark., is General Manager. (See Construction Supplement.)

CHICAGO, ROCK ISLAND & PACIFIC.—An officer writes that this company has not authorized an extension from Ardmore, Ind. T., west to Waurika. The report that the company is planning to build such a line is without foundation.

CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS.—According to newspaper reports, preparations are now being made for the reconstruction of the Michigan Division of this road between Benton Harbor, Mich., and Indianapolis, Ind. It is stated that work will be begun at once, and will include the regrading and reballasting of a large part of the line between these points.

COLUMBIA & NORTHWESTERN.—A charter has been granted this company in Arkansas to build a railroad from Old Lumber between Waldo and Buckner, in Columbia County, in a southerly direction to Macedonia, 18 miles. J. J. Cochran, G. W. McKay, J. S. Jones and others are incorporators.

COLUMBUS, MEMPHIS & PENSACOLA.—Press reports state that this company has completed surveys for a line from Columbus, Miss., to Amory, 34 miles, with a branch line from Columbus north to Aberdeen, 25 miles. W. M. Foster, Columbus, Miss., is in charge of the work, and Newman Cayce, Aberdeen, Miss., is President. (April 1, p. 264.)

DARIEN & WESTERN.—It is reported that this company is planning to build an extension in a westerly direction for a distance of seven miles. The road now runs out of Darien Junction, Ga., for a distance of eight miles, where it connects with the Seaboard Air Line. The present plan is to build from the end of this extension to a connection with the Atlantic Coast Line. F. H. McFarland, Darien, Ga., is General Manager. (March 18, p. 222.)

EASTERN TEXAS.—An officer writes that, although this company is planning to build an extension to Crockett, Tex., the work will not be begun during the present year. The proposed extension is 30 miles long, and it is probable that the company will be in a position to build the line during the coming year. J. A. Sargent, Kansas City, Mo., is President. (May 27, p. 410.)

GUTHRIE, FAIRVIEW & WESTERN.—According to newspaper reports, the location surveys for this proposed railroad from Guthrie northwest through Kingfisher to Fairview, 70 miles, are practically completed. It is stated that contracts for grading will be let as soon as the surveys are finished. This road is reported to be a project of the Kansas City, Mexico & Orient. W. S. McCaull, Guthrie, Okla. T., is President. (May 6, p. 354.)

HARRISON CENTRAL.—Press reports state that work will be begun on this road within the next 60 days. The proposed route is from Harrison, Ark., northeast to a point on the White River branch of the St. Louis, Iron Mountain & Southern near Keener, 10 miles. It is stated that the Keene Construction Co., of Powell, Ark., will do the grading. J. A. Bunch, Harrison, Ark., and T. N. Chenoweth, Mountain Home, Ark., may be addressed. (May 20, p. 392.)

KANAWHA, GLEN JEAN & WESTERN.—A contract for grading the first four miles of this line from Thurmond, W. Va., to Kilsyth, 11 miles, has been awarded to the George W. Wilson Co., of Marbleboro, Md. Grading will be begun at once. T. C. McKell, Chillicothe, Ohio, is President, and Thomas Nichol, Kilsyth, W. Va., is Chief Engineer. (See Construction Supplement.)

KINGSTON & EMORY GAP.—This company has been incorporated in Tennessee to build a railroad from Kingston northwest to a point on the Tennessee Central near Emory Gap, about six miles.

LAKE & RIVER.—The completed portion of this road, extending from Ashland, Ohio, to Custaloga, 25 miles, and formerly known as the Ashland & Wooster, was sold under foreclosure proceedings at Ashland, Ohio, on May 25. The road was purchased by the Cleveland Trust Co., of Cleveland, for $250,000.

MOUNT STERLING SHORT LINE.—Articles of incorporation have been filed by this company in Kentucky. It is proposed to build a railroad from Mount Sterling through the County of Montgomery to a point in Clark County near Indian Fields, where connection will be made with the Lexington & Eastern. W. M. Beckner, E. S. Jouett and others, of Winchester, Ky., are incorporators.

NORTHERN PACIFIC.—An officer writes that this company is planning to extend its Bitter Root branch from Charlis, Mont., in a southerly direction for a distance of 7.8 miles. The contract for building this extension has been let to Winters, Parsons & Boomer, Spokane, Wash. Work has been begun and it is stated that the line will be completed within four months. The new line will be used mostly for logging.

OXFORD, COCHRANVILLE & PARKESBURG (ELECTRIC).—Application has been made by this company for a charter to build an electric railroad from Oxford through Hayesville and Russellville to Cochranville, and thence northeast to Parkesburg, Pa., 14 miles. T. C. O'Connell, Westchester, Pa., may be addressed.

PENNSYLVANIA.—Bids are being received by this company for building the Duquesne Way elevated freight line in Pittsburg. The road will be about one mile long with two short branches. It will start from a connection with the Pennsylvania tracks just west of the union station and pass along Duquesne Way over the approaches to the Ninth, Seventh and Sixth street bridges, across the Allegheny River over Fifth and Fourth streets and thence over Third street to the large freight yards which are to be made by the company in the block bounded by Third and Water streets, Duquesne Way and Pennsylvania avenue. The ordinance permitting the building of this elevated line was recently passed by the Pittsburg Council. (March 11, p. 200.)

QUEBEC SOUTHERN.—Judge Burbidge, of the Exchequer Court, Montreal, has ordered the sale of the Quebec Southern and its South Shore Division. The terms of the sale are to be determined by the court on June 25. In the meanwhile, the creditors of the lines will communicate their views on the manner of the sale, and notices will be given to the registrar of the Exchequer Court. The Quebec Southern runs from Sorel to Noyan Junction, 88 miles, while the South Shore Division runs from Montreal to St. Francois-du-Lac, 68 miles.

RALEIGH & WESTERN.—An officer writes that final surveys have been made for the proposed extension of this road from Colon, N. C., to Salem, 90 miles. Grading has been completed between Colon and Harpers, 21 miles. Final surveys have also been made for an extension from Randleman Junction to Greensboro, N. C., 19 miles, and from Colon to Sanford, four miles. G. C. McGregor, Cumnock, N. C., is Chief Engineer. (See Construction Supplement.)

RISON & MOUNT ELBA.—A charter has been granted this company in Arkansas, capital stock $25,000. The road is already running between Rison and Mount Elba, 10 miles, and is operated as a private enterprise, but is to be incorporated so that it may participate in the division of freight rates under the regulations laid down in the recent "Tap-line" decision of the Interstate Commerce Commission. D. F. Swanson, Rison, Ark., may be addressed.

ST. LOUIS, BROWNSVILLE & MEXICO.—An officer writes that surveys are now in progress by Johnston Bros., St. Elmo, Ill., for an extension of this road from Sinton, Texas, northeast through Refugio, Lacedo and Bay City to Columbia, 150 miles. It is stated that an agreement has been made with the International & Great Northern for the use of that company's tracks from Columbia to Houston, so that, as soon as this extension is completed, the St. Louis, Brownsville & Mexico will have a direct line from Brownsville to Houston. The main part of this company's road from Robstown, Texas, to Brownsville, 141 miles, is now practically completed. F. G. Jonah, Corpus Christi, Texas, is Chief Engineer. (May 20, p. 392.)

SAN ANTONIO & CARTHAGE.—Articles of incorporation have been filed by this company in New Mexico. It is proposed to build a railroad from San Antonio north to Carthage in Socorro County, five miles. D. H. McMillan, Socorro, N. Mex.; J. H. Vaughn and E. L. Bartlett, Santa Fe, N. Mex., are incorporators. The principal office of the company will be at Socorro.

SAN PEDRO, LOS ANGELES & SALT LAKE.—A contract has been awarded to the Utah Construction Co., of Ogden, Utah, for building a branch line from Frisco to Newhouse, Utah, about nine miles. Grading is now in progress. Track has been laid on the main line as far as the eighty-fifth mile post out of Calientes, Nev.

TORONTO, HAMILTON & BUFFALO.—At a recent meeting of the stockholders of this company, it was voted to issue $1,000,000 of debenture stock, the proceeds to be used in improving the road and for new equipment. This road is controlled by Vanderbilt and Canadian Pacific interests.

WADLEY & MT. VERNON.—At a recent meeting of the directors of this company, it was voted to extend the line from Douglas, Ga., southwest to Leliaton, 15 miles. Connection will be made at the latter point with the Atlantic Coast line and with the Ocilla, Pinebloom & Valdosta. J. P. Lawrence, Douglas, Ga., is Chief Engineer. (See Construction Supplement.)

WILMAR & SALINE VALLEY.—A charter has been granted this company in Arkansas to build from Wilmar to Bailey, in Drew County, 13 miles. E. W. Gates, A. H. Gates, H. C. Rule and others, of Wilmar, Ark., are incorporators.

YUKON-VALDEZ R. R.—Incorporation has been granted this company in Virginia with an authorized capital stock of $10,000,000. It is proposed to build a railroad from a point on the bay of Valdez, in Alaska, to a point near Eagle City, about 350 miles. J. W. Wilcox, Norfolk, Va., is said to be interested.

GENERAL RAILROAD NEWS.

ATLANTIC & NORTH CAROLINA.—On June 1, Chief Justice Fuller of the United States Supreme Court suspended the operation of the order appointing a receiver for this road until the next meeting of the Circuit Court of Appeals at Richmond in October. Thomas D. Meares, of Wilmington, N. C., was appointed receiver on May 28 by Judge Purnell of the United States Circuit Court at Raleigh on application of J. P. Cuyler and K. S. Kinch, minority stockholders. The Atlantic & North Carolina extends from Goldsboro to Morehead City, a distance of about 100 miles, and is valued at about $2,000,000. Two-thirds of the stock is owned by the State of North Carolina and the remainder by private individuals. Charges of mismanagement were the cause of the application for a receivership. By the decision of Chief Justice Fuller revoking the order appointing a receiver, the road will now revert into the hands of the State of North Carolina under a bond of $25,000.

BRONX TRACTION.—This company has been incorporated at Albany with an authorized capital of $587,000 as a consolidation of the following New York city companies: Suburban Traction; Wakefield & Westchester Traction; West Farms & Westchester Traction; Williams Bridge & Westchester Traction, and the Van Nest, West Farms & Westchester Traction companies. Among the directors are D. B. Hasbrouck and C. E. Warren, who are respectively President and Vice-President of the Metropolitan Street Railway Co.

LEHIGH & HUDSON.—See Philadelphia & Reading below.

LEHIGH & LACKAWANNA.—See Lehigh Coal & Navigation Co. below.

LEHIGH COAL & NAVIGATION CO.—This company has bought the Lehigh & Lackawanna. This action is merely a formal step made necessary by the default on the part of the Lehigh & Lackawanna for 26 years of the payment of interest on the $100,000 first-mortgage bonds held by the Lehigh Coal & Navigation Co.

NEW ORLEANS TERMINAL CO.—A recent decision of the Supreme Court of Louisiana states that the City Council of New Orleans had no authority to grant the right to lay tracks on the banks of the Mississippi River within the limits of the City of New Orleans, as the administration of this territory is lodged solely with the Board of Commissioners of the port of New Orleans. After much opposition, the City Council, last year, granted certain of the neutral grounds in the city and gave a franchise to the New Orleans Terminal Co. to operate a belt line within the city limits, together with the privilege of further improving its property by the erection of wharves, elevators and other facilities. It is stated that this decision of the Supreme Court will somewhat affect the proposed plans for the joint terminal of the Southern and Rock Island railroads at this point.

NEW YORK & PENNSYLVANIA.—A certificate of consolidation of the New York & Pennsylvania and the Sharon & Ceres has been filed with the Secretary of State in New York. The former road runs from Canisteo, N. Y., to Ceres, 57 miles. The Sharon & Ceres was built in 1901 from Shinglehouse, Pa., to Ceres, N. Y., five miles. The capital stock of the consolidated company is $507,000.

OZARK & CHEROKEE CENTRAL.—Mason, Lewis & Co. and Farson, Leach & Co., New York, are offering at 98 and interest $2,800,000 of this company's $3,000,000 first-mortgage 5 per cent. gold bonds due in 1913. These bonds are guaranteed principal and interest by the St. Louis & San Francisco and are redeemable at the option of the company at par and interest upon 60 days' notice. The Ozark & Cherokee Central is now completed between Fayetteville, Ark., and Okmulgee, Ind. T., 144 miles. The stock of the company is owned by the St. L. & S. F. and the property is bonded at the rate of $20,000 per mile. Of the $3,000,000 bond issue, $120,000 has been reserved for the retirement of $100,000 of bonds of the Muskogee City Bridge Co.

PENNSYLVANIA.—Announcement has been made that the final installment of 25 per cent., amounting to $15 a share on the $75,000,000 stock issue is due between June 15 and June 25. Stockholders of record May 9, 1903, were given the privilege to subscribe at $60 per share for new stock to the amount of 33⅓ per cent. of their holdings. The payments for this new stock were to be made in three installments, the first installment of $30 a share being payable at the time of subscription, the second of $15 a share being payable between October 15 and 26, 1903, and the third of $15 a share being payable between June 15 and 25, 1904. Nearly all of the stock was paid for in full in October of 1903.

PHILADELPHIA & READING.—Official announcement has been made by the Philadelphia & Reading of the purchase of a controlling interest in the stock of the Lehigh & Hudson River. This purchase was made in the interest of the Central R. R. of New Jersey, the Lehigh Coal & Navigation Co. and the Philadelphia & Reading. The Lehigh & Hudson has been controlled for some time by the Central of New Jersey and the Lehigh Coal & Navigation Co., which jointly guarantee the general mortgage bonds of the L. & H. The L. & H. extends from Belvidere, N. J., to Greycourt, N. Y., 63 miles, and forms a connection between the C. of N. J. and the Central New England (Poughkeepsie bridge route).

ST. LOUIS & SAN FRANCISCO.—The directors of this company have voted to issue $1,000,000 of the recently authorized $85,000,000 refunding bonds for the purpose of reimbursing the treasury for advances on account of improvements and additions. Under the refunding mortgages clause, $1,000,000 of bonds may be issued and sold each year for such purposes up to $6,000,000. The directors have also ratified the traffic agreement made with the St. Louis, Iron Mountain & Southern for an entrance into New Orleans.

ST. LOUIS, MEMPHIS & SOUTHEASTERN (S. L. & S. F.).—The plan for refunding all the outstanding securities of this company as well as those of the St. Louis & Gulf and of reimbursing the St. Louis & San Francisco for advances made amounting to $3,700,000 for construction on the above lines has been ratified by the stockholders. The securities to be retired are: S. L. M. & S. E. first mortgage bonds, amounting to $9,188,500; S. L. & G. first mortgage bonds, amounting to $5,852,000; S. L., M. & S. E. capital stock, $12,500,000; S. L. & G. capital stock $6,000,000. For the purpose of retiring the above securities, there will be issued S. L., M. & S. E. guaranteed first mortgage bonds bearing 4½ per cent. interest and running for five years. These bonds will be subject to call at the company's option at par and interest, and will be a first lien upon the 674 miles of main line of the above companies. They will be guaranteed principal and interest by the St. Louis & San Francisco.

ST. LOUIS, SAN FRANCISCO & TEXAS.—An amendment has been filed to the charter of this company increasing its capital stock from $200,000 to $3,000,000. This increase in capital stock is preliminary to the formal consolidation of this road with the Blackwell, Enid & Texas, the Oklahoma & Texas and the Red River, Texas & Southern railroads.

WISCONSIN CENTRAL.—The stockholders of this company have been requested by the voting trustees to surrender the voting trust certificates on and after June 15 at the office of Maitland, Coppell Co., 52 William street, New York City. In exchange for these voting trust certificates, on and after July 1, the common and preferred stock of the company will be delivered to the stockholders. This road has been controlled by a voting trust since its reorganization in July, 1899. After the termination of the voting trust on July 1, the preferred stockholders are to have the right to elect the majority of the Board of Directors whenever, for two years in succession, dividends upon the preferred stock at the rate of 4 per cent. a year shall not have been paid in cash. No dividend has as yet been paid upon the preferred stock.